Area of Concern Investigation Report
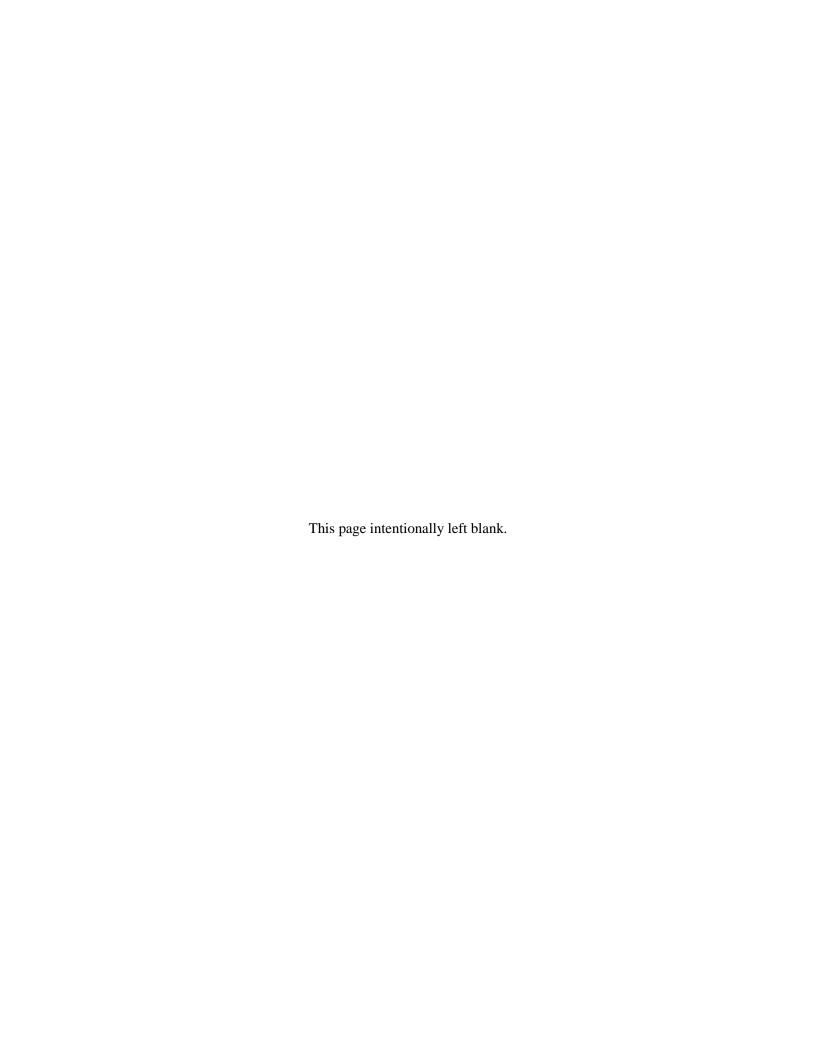
Chevron Phillips Chemical Puerto Rico Core, LLC

Prepared for:
Chevron Phillips Chemical Puerto Rico, LLC

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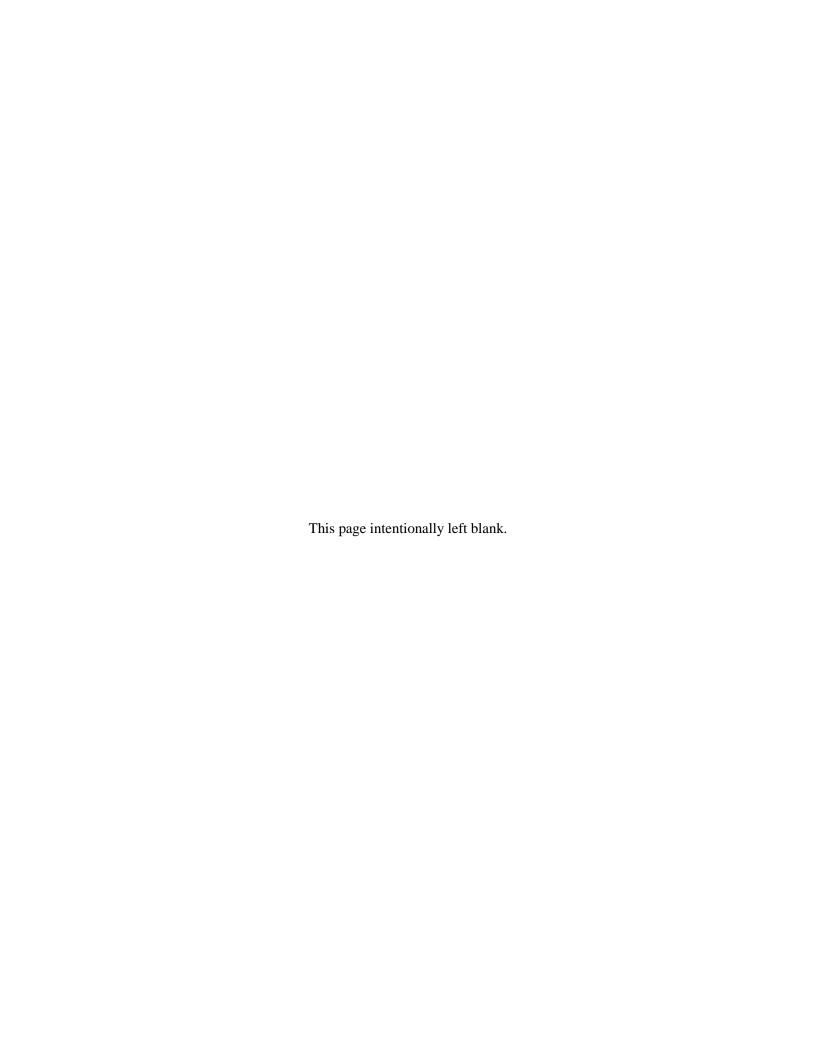
Area of Concern Investigation Report

April 2013

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ACRONYMS

AES	Advanced Energy System
AOC	Area of Concern
AST	aboveground storage tank
AWPI	Ayerst Wyeth Pharmaceuticals, Inc.
bgs	below ground surface
BMP	best management practice
BTEX	benzene, ethylbenzene, toluene and xylenes
CD	compact disk
CDI	chemical daily intake
CMI	Corrective Measures Implementation
CMS	Corrective Measures Study
COC	chemical of concern
COPC	chemical of potential concern
CPCPRC	Chevron Phillips Chemical Puerto Rico Core, LLC
CSM	conceptual site model
CTE	central tendency exposure
DL	detection limit
DPE	dual-phase extraction
DQO	data quality objective
EFR	Enhanced Fluid Recovery
EI	Environmental Indicator
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
ERA	ecological risk assessment
ESL	ecological screening level

ft	feet or foot
gpm	gallons per minute
HEAST	Health Effects Assessment Summary Table
HHRA	Human Health Risk Assessment
HI	hazard index
HWMU	hazardous water management unit
ILCR	incremental lifetime cancer risk
IRIS	Integrated Risk Information System
LNAPL	light non-aqueous phase liquid
MPS	media protection standard
msl	mean sea level
NCEA	National Center for Environmental Assessment
NCP	National Contingency Plan
NPDES	National Pollutant Discharge Elimination System
OSRTI	Office of Superfund Remediation and Technology Innovation
OSWER	Office of Solid Waste and Emergency Response
PAH	polynuclear aromatic hydrocarbon
PC	permeability constant
PID	photoionization detector
PPE	personal protective equipment
ppm	parts per million
PPRTV	Provisional peer-reviewed toxicity values
PRASA	Puerto Rico Aqueduct and Sewer Authority
PREQB	Puerto Rico Environmental Quality Board
RAIS	Risk Assessment Information System
RBC	risk-based concentration

RBSL	risk-based screening level
RCRA	Resource Conservation and Recovery Act
RfC	reference concentration
RfD	reference dose
RFI	RCRA Facility Investigation
RME	reasonable maximum exposure
SF	slope factor
SLERA	Screening Level Ecological Risk Assessment
SMP	Soil Management Plan
SRFI	Supplemental RFI Work Plan
SVOC	semi-volatile organic compound
UCL	upper confidence level
URF	unit risk factor
USCS	Unified Soil Classification System
VISM	Voluntary Interim Stabilization Measure (System)
VOC	volatile organic compound
WWTP	Wastewater Treatment Plant

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Area of Concern Investigation Report

1.   INTRODUCTION

In September 1995, the U.S. Environmental Protection Agency (EPA) and Chevron Phillips Chemical Puerto Rico Core, LLC's (CPCPRC) predecessor, Phillips Puerto Rico Core Inc., entered into an Administrative Order on Consent (the "Order"), Docket No. II Resource Conservation and Recovery Act (RCRA)-95-3008(h)-0307 for its facility in Guayama, Puerto Rico (the "Facility"). In general, that Order required the following:

- Development of work planning documents,

- Laboratory, field and bench-scale studies,

- Field investigations and associated RCRA Facility Investigation (RFI) Report of groundwater, soil, sediment, air and surface water impacts,

- Investigation analyses, analyzing the RFI data with respect to the adequacy of data (i.e., any data gaps),

- Risk assessment, human health and the environment,

- Corrective Measures Study (CMS) and

- Corrective Measures Implementation (CMI).

Since 1995, CPCPRC completed the majority of the work identified in the 1995 Order. The following presents a brief summary of that work (documentation on file in the project records):

1995 to 1999	Work planning, laboratory and bench-scale studies, and field investigations of groundwater, soil, sediment, air and surface water impacts.
July 1999	CPCPRC completed the RFI and submitted the Final RFI Report to the EPA.
January 2000	EPA issued a letter (dated January 4, 2000) wherein EPA approved the RFI on the condition that the CMS address the EPA's noted concerns.
October 2003	EPA determined that the benzene, ethylbenzene, toluene and xylenes (BTEX) plumes are stable and posted the determination (the Groundwater Environmental Indicator [EI]) on the EPA web site.
November 2004	CPCPRC submitted the Final Risk Characterization Report (CPCPRC, 2004), which addressed EPA's concerns and presented the media-specific media protection standards (MPSs).
February 2005	The Final Risk Characterization Report (CPCPRC, 2004) was approved in an email dated February 1, 2005.
March 2006	EPA and CPCPRC agreed that the RFI phase of the work had been completed at the facility and that work planning for the CMS could begin.

October 2006	CPCPRC submitted the Final CMS Work Plan.
April 2007	CPCPRC submitted the Draft Site-Wide CMS Report.
September 2007	The Puerto Rico Environmental Quality Board (PREQB) provided comments on the Draft Site-Wide CMS Report.
August 2008	CPCPRC announced the permanent cessation of operations at the Facility and its intent to decommission and dismantle the process units, tanks, and related equipment.
2009-2011	The dismantling activities were implemented and involved the physical dismantlement of equipment, tanks, and piping for sale, reuse, or recycling. During this time, CPCPRC performed initial characterization sampling of soil in areas exposed by demolition.
October 2011	CPCPRC, EPA and EQB meet to discuss the scope and schedule for the CMS Report considering the initial characterization sampling of soil in areas exposed by demolition.
4th Quarter 2011	Decommissioning and dismantlement was completed and 19 Areas of Concern (AOCs) were identified based on the initial sampling efforts.

Current activities at the Facility include decommissioning activities associated with the wastewater treatment process, routine groundwater monitoring related to the Order and ongoing interim measures conducted through implementation of the Enhanced Fluid Recovery (EFR) system and the Voluntary Interim Stabilization Measure (VISM) system.

The EFR is a mobile variation of what is commonly referred to as dual-phase extraction, vacuum enhanced recovery, multi-phase extraction, or "bioslurping." The performance of the EFR system is reported in quarterly progress reports and in an annual summary report submitted to the EPA and the PREQB.

The VISM system is composed of an air-sparging trench along a portion of the eastern Facility boundary, vapor recovery system, and vapor treatment units. The performance of the VISM system is reported in semi-annual progress reports submitted to the EPA and PREQB.

1.1   Purpose

Prior to commencement of the decommissioning and dismantlement activities, it was recognized that, although extensive site characterization activities had been performed, it was possible that previously unknown historical contamination may be discovered as the decommissioning and dismantlement activities progressed. Considering this possibility, CPCPRC developed the Soil Management Plan (SMP). The SMP (North Wind, 2009) was used as a field management guide by personnel who discovered contamination during the course of the dismantling activities at the Facility. The SMP guidelines provided the mechanism in accordance with Section VI of the Order for identifying newly discovered contamination, controlling exposure to that contamination and, for notifying EPA and PREQB of that discovery.

It is noted that, in the Order (Section VI), any newly discovered contamination would be designated a Solid Waste Management Unit. In discussions with the EPA and PREQB, it was agreed that newly discovered areas of contamination are more appropriately termed AOCs. Further, there was agreement

that AOCs identified during the decommissioning would undergo additional characterization to delineate the nature and extent of contamination.

Since the Order's inception, CPCPRC has implemented this process of identifying, reporting and, investigating contamination at the Facility to develop a comprehensive list of chemicals for investigation. Based on investigation findings, operational knowledge of the chemicals used in significant quantity and the process identified in Section VI of the Order, a list of 74 chemicals that could be present at the Facility has evolved. The basis for the list was the Skinner List of approximately 60 chemicals developed by the EPA in the 1980s. This list has evolved over time and has been modified to 74 chemicals for the Facility. The most recent addition to the list was sulfolane. Sulfolane was discovered beneath a demolished structure (Tank 540). Tank 540 was used for sulfolane storage and sulfolane was detected in the soil during the tank dismantling. The Modified Skinner list for the CPCPRC facility is presented in Table 1-1.

The purpose of this AOC Investigation Report is to document the field activities and findings of the AOC investigation completed during the fall of 2011 and January of 2012. In addition, this report presents the analytical results for a complete round of groundwater sampling at 78 site monitoring wells and 3 effluent channel surface water and sediment sample locations in May/June 2012 and a round of groundwater sampling at 54 regularly monitored wells and 3 effluent channel surface water and sediment sample locations in December 2012. These sampling events performed subsequent to the AOC investigation are intended to augment the AOC investigation results and provide stakeholders with a complete description of the nature and extent of contamination.

The description of the nature and extent of contamination and the associated risk assessment results will finalize the characterization phase of the RCRA process and support the scope of the CMS phase of work at the Facility.

1.1.1 AOC Investigation Objectives and Approach

The objectives of the AOC investigation were to characterize the nature and extent of contamination at each of the 19 AOCs and use these data to determine the risk posed by the contamination. Each of the 19 AOCs was treated as an individual area in terms of sample collection, regardless of size or proximity to other AOCs. Characterization of each AOC was detailed in the AOC Investigation Work Plan (North Wind, 2011a) and included a specified number of surface soil samples, subsurface soil samples and groundwater samples. In addition to the planned work, CPCPRC performed additional sampling, as necessary, based on field and analytical data, to complete the delineation of contamination.

Analytical data obtained from the sampling was validated by an independent, Puerto Rico certified data validator. The specific methods and procedures used during the completion of the AOC investigation are presented in the following sections of this report.

1.2 Site Background

The Facility was constructed in 1966 and was a specialty chemicals production facility that operated from 1966 to 2004. The CPCPRC facility was constructed to primarily process naphtha into a variety of refined hydrocarbon products including, but not limited to benzene, toluene, xylenes, cyclohexanes, liquid petroleum gas, gasoline and diesel fuels. Through inadvertent releases, these products have been introduced into the environment primarily through the release of liquid product to shallow groundwater.

1.2.1   Site Setting and Use

The Facility is 211 acres in size and is located on the southeast coast of Puerto Rico centered at approximately 17°56'45" north latitude and 66°08'30" west longitude. CPCPRC is located about 0.25 miles north of the Caribbean Sea (Figure 1-1).

The surrounding area is predominantly industrial, with a small community, Las Mareas, south of the Facility and Colonia Reunion, north of the Facility. Prior to demolition, the Facility consisted of a Process Area with structures, piping and other appurtenances on a concrete slab and product storage in Tank Basins A through N. Some other smaller areas of product storage were located in the northern portion of the Facility. The administrative offices and other support services were also located in the northern portion of the Facility. Near the southern portion of the Facility, there is a Wastewater Treatment Plant (WWTP) and associated ponds and structures.

With the exception of the WWTP and some other minor facility features (e.g., the fire water hydrants), the Facility is completely demolished. Figure 1-2 presents a map of the Facility.

Based on current surrounding land use and likely expectations of future land use, the Facility will remain industrial.

1.2.2   RFI Investigations

In 2004, CPCPRC completed the RFI phase of the project by submitting the Final Risk Characterization Report (CPCPRC, 2004). During the RFI, a large data set was compiled through the various investigations that were performed. Analyses were performed on 370 chemicals from 450 samples of media, including groundwater, soil, sediment, surface water and air. The results of the RFI work and subsequent risk assessment demonstrated that of the 370 chemicals analyzed, only 12 were identified as chemicals of concern (COCs); with the primary facility-related contamination being petroleum hydrocarbons (benzene, in particular).

1.2.3   Semi-Annual Groundwater Sampling

Since 1999, CPCPRC has been sampling a subset (45) of the 116 existing site monitoring wells on a semi-annual basis. The monitoring wells primarily include wells located offsite and along the boundaries of the facility. The objective of this semi-annual sampling is to track groundwater contamination and verify that the migration of contaminated groundwater is controlled until the CMS remedy for groundwater is implemented. The analytical suite used to track groundwater contamination consists of a subset of the Modified Skinner List of chemicals.

Subsequent to performing the AOC investigation and in the time leading to the preparation of this report, it was recognized that to obtain a more complete data set for risk assessment, an expanded list of groundwater monitoring wells should be sampled and the groundwater analyzed for the Modified Skinner List of chemicals presented in Table 1-1.

Considering the overall objective to obtain a complete and current picture of the nature and extent of facility-related contamination, CPCPRC voluntarily decided to sample 78 monitoring wells and analyze the groundwater for the Modified Skinner List of chemicals (Table 1-1). In addition, the surface water and sediment in the effluent channel were sampled and analyzed for the Modified Skinner List of chemicals (Table 1-1). This sampling was conducted in May/June 2012 and represents an expanded semi-annual sampling event. The results of this sampling are used in the risk assessment presented herein.

1.2.4   Ongoing Interim Actions

The following describes the interim actions that are ongoing at the Facility to address groundwater contamination.

1.2.4.1   Enhanced Fluid Recovery

CPCPRC has been implementing EFR in focused areas of the Facility since September 1996. EFR is a mobile variation of what is commonly referred to as dual-phase extraction (DPE), vacuum enhanced recovery, multi-phase extraction or "bioslurping." Extracted fluids are temporarily contained in the tank of a specially equipped vacuum truck for subsequent treatment at the Facility's Air Stripper. This treated water is then discharged to the Puerto Rico Aqueduct and Sewer Authority (PRASA). Over the last several years, the absence of releases, natural attenuation and the application of EFR has resulted in significant improvement in groundwater quality. The observed changes include the absence of light non-aqueous phase liquid (LNAPL) in the wells and significant declines in dissolved phase benzene concentrations in several wells.

CPCPRC's EFR program includes revisiting the EFR application approach on the quarterly basis to tailor the extraction regime based on the most current benzene data. As an interim measure, the application of EFR has been effective at reducing the mass of benzene in groundwater. The effectiveness of EFR as the final remedy or part of the final remedy will be evaluated in the CMS. Until the final remedy is determined and in place, CPCPRC continues to implement an aggressive EFR program to further reduce benzene mass in groundwater.

1.2.4.2   Voluntary Interim Stabilization Measure

The VISM system was constructed as a voluntary interim measure to reduce benzene levels in the upper alluvial aquifer near the southeastern boundary of the Facility. The VISM system consists of an air sparging trench, vapor recovery system and vapor treatment units. In addition, a 12-inch diameter well was installed at the south end of the trench to facilitate removal of any free-phase petroleum hydrocarbon that may collect in the trench and/or the recovery well. The VISM system has been operating since 1996.

BTEX concentrations have been tracked over the last 15 years. It is observed that BTEX levels in groundwater have been below the performance standard established for the VISM of 200 parts per million (ppm) at all of the VISM wells and piezometers since June 2009.

The effectiveness of VISM as the final remedy, or part of the final remedy, will be evaluated in the CMS. Until the final remedy is determined and in place, CPCPRC continues to operate the VISM system to further reduce BTEX levels in groundwater.

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2. AOC INVESTIGATION

The AOC investigation approach was based on the conceptual site model (CSM) of chemical release and transport. Facility-related chemical contaminants could have been released (source) onto surface soil (primary source medium or source zone), could then have infiltrated through the subsurface soil (secondary source medium), and could then be transported away from the source via groundwater (primary transport medium). Considering this, surface soil, subsurface soil and groundwater were investigated.

During the deconstruction and dismantlement of the facility, areas of potential contamination were identified and sampled. If the analytical results indicated contamination was present above the risk-based screening levels (RBSLs), the area was retained as an AOC for further investigation and characterization.

Sampling efforts completed during the deconstruction and dismantlement of the facility identified 19 AOCs (Figure 1-2). Table 2-1 presents a list of the identified AOCs along with information regarding their size and former use.

2.1 AOC Investigation Sampling Program

The AOC investigation field work was performed after complete demolition of the Facility and was conducted in two phases: the first in August/September 2011 and the second in January 2012. The work was conducted in two phases because some of the investigation locations were inaccessible in August/September 2011 as a result of rainfall and muddy conditions.

Each of the 19 AOCs identified during the deconstruction and dismantlement of the Facility were characterized as individual areas. The sample design for each AOC was based on the grid developed for that individual AOC (North Wind, 2011a). The sizes of the AOCs ranged from 20 feet (ft) in diameter to 212 ft in diameter and the number of grid nodes was dependent upon the size of the AOC and the data quality objectives (DQOs) of the investigation. The specific number and the location of the samples are presented in the AOC-specific discussions below.

In addition to the samples identified in the Work Plan (North Wind, 2011a), analytical results from the August/September 2011 field event and field observations, such as elevated photoionization detector (PID) readings and/or obvious visual or olfactory signs that contamination may be present beyond the grid location, were used to augment the sampling program in January 2012. In these cases, additional boring(s), termed step-out locations, were drilled at some AOCs to bound the lateral and vertical extent of the contamination.

All borings were drilled using a direct push drilling system and soil sampling was completed by obtaining core material from the selected depth and immediately filling the sample jar(s) for volatile organic compound (VOC) analysis. The semi-volatile organic compounds (SVOCs) and metals analyses were collected by mixing the appropriate segment of the core to yield sufficient material for analysis.

- Two groundwater samples were collected at each AOC: one at an upgradient location and one downgradient location. Prior to commencing fieldwork, a potentiometric surface map was generated using water levels measured during the most recent sampling event. The potentiometric surface map is included in Appendix A along with the lithologic logs for each of the borings. Prior to sampling, the map was consulted to verify upgradient and downgradient sample locations). Upon completion of sampling the borings were backfilled using native materials (unused core) and any remaining void space was filled with grout.

- The soil core was described using the Unified Soil Classification System (USCS) system and the boring logs for the 271 investigation locations are provided in Appendix A. The collected samples were analyzed for Modified Skinner List (Table 1-1). The laboratory data packages were submitted to CPCPRC and an independent, Puerto Rico certified data validator completed the validation of all the analytical data.

- As part of the best management practices (BMPs) for preventing the spread of contamination, the AOCs have remained covered either by leaving the tank bottom in place or in the case of Tank 540, by placing an 18-inch layer of concrete over the AOC. Locations that were drilled through the in-place tank bottoms or the concrete at Tank 540 were patched with sheet metal or concrete, respectively.

2.1.1   Surface Soil

Direct push drilling methods to obtain soil core from the ground surface to the top of groundwater. Consistent with the RFI characterization work, one soil sample was collected from the 0- to 2-ft depth interval (surface soil). During the AOC investigation, a total of 259 surface soil samples were collected and analyzed for the Modified Skinner List (Table 1-1).

2.1.2   Subsurface Soil

For soil intervals below the surface soil sample (i.e., subsurface soil), a portion of each 4-ft section of core was placed in a sealable plastic bag and a PID was used to measure the headspace in the bag after the sample equilibrated. One soil sample was collected from the interval exhibiting the highest PID headspace reading relative to ambient background. If no 4-ft section of core exhibited elevated headspace readings relative to ambient background, the sample from the interval directly above the water table at the time of drilling was selected for laboratory analysis. During the AOC investigation, a total of 259 subsurface soil samples were collected and analyzed for the Modified Skinner List (Table 1-1).

2.1.3   Tank Platforms

During the AOC investigation, it was observed that the former aboveground storage tanks (ASTs) were constructed on raised soil platforms. The platforms ranged in height from about 1 foot at Tank 240 up to maximum of approximately 8 ft at Tank 170. As discussed later in this report, the tank platforms need to be considered when discussing contaminant extent and fate.

2.1.4   Groundwater

The groundwater samples were collected at each AOC from the open borehole using a peristaltic pump with dedicated tubing. Groundwater was typically found between 4 and 8 ft below ground surface (bgs). If groundwater was not encountered, the borehole was advanced to a maximum depth of 20 ft bgs. However, at a few locations the boring was advanced beyond 20 ft to 28 ft. These borings were advanced to locate the clay aquitard located between the upper and lower alluvial aquifer. Water was not located at two borings during drilling. At location 0403-11, the boring was dry at 20 ft. At boring 0401-11, the boring was dry at 16 ft. This boring was halted at 16 ft when the clay aquitard separating the upper and lower aquifers was encountered. During the AOC investigation, a total of 38 groundwater samples were collected from the open boreholes and analyzed for the Modified Skinner List (Table 1-1). The locations for the borings at each AOC are presented in Figure 4-2 through Figure 4-20. The boring logs are included in Appendix A and depict where water was encountered during drilling and the total depth drilled at each location.

2.1.5   Effluent Channel Surface Water

The water in the effluent channel is regularly sampled for a target list of chemicals as part of the ongoing semi-annual monitoring program. Subsequent to the AOC investigation, it was decided to sample the surface water for the modified Skinner list chemicals to complete the nature and extent evaluation and risk assessment presented herein. Three surface water samples were collected and analyzed for the Modified Skinner List (Table 1-1).

2.1.6   Effluent Channel Sediment

The sediment in the effluent channel is sampled semi-annually along with the surface water for a target list of chemicals. Subsequent to the AOC investigation, it was decided to sample the sediment for the Modified Skinner List chemicals to complete the nature and extent evaluation and risk assessment presented herein. Three sediment samples were collected and analyzed for the Modified Skinner List (Table 1-1).

2.1.7   Background Metals Sampling

Surface soils unaffected by the site activities were last sampled at 10 locations in 1998 to determine the ambient levels of metals in soil. During the AOC investigation, 10 new samples were collected from the same 10 locations. These data were collected to provide analytical data that are contemporaneous with the AOC samples and that used the same analytical methods as the AOC samples.

2.2   DEVIATIONS FROM THE WORK PLAN

As mentioned previously, in addition to the samples identified in the Work Plan (North Wind, 2011a), analytical results from the August/September 2011 field event and field observations, such as elevated PID readings and/or obvious visual or olfactory signs that contamination may be present beyond the grid location, were used to augment the sampling program in January 2012. In these cases, additional boring(s), termed step-out locations, were drilled at some AOCs to bound the lateral extent of the contamination.

During the drilling, it was realized that the majority of the locations identified in the Work Plan for the upgradient groundwater sample locations were actually within the footprint of the former tank. Because of this, these samples would likely not have provided a representative sample of the groundwater flowing from upgradient of the tank. In these cases, an additional step-out boring was drilled outside the footprint of the former tank to ensure that a representative sample of the groundwater upgradient of the tank was collected.

The grid spacing at AOC 540 was larger than the grid identified in the AOC work plan due to the actual size of the cement patch poured over the area. The cement patch was used as the AOC boundary. No other deviations from the Work Plan occurred.

2.3   SECONDARY FIELD ACTIVITIES

2.3.1   Field Equipment Calibration Procedures

Field instruments were calibrated and maintained in accordance with the manufactures specifications. The PID was calibrated daily prior to use and as necessary. The groundwater quality meter was calibrated daily prior to use.

2.3.2 Field Decontamination Procedures

All Direct Push tooling (drill rods, bits, caps) that contacted contaminated soil were decontaminated between each use. Sampling equipment such as spoons, were decontaminated between each use. Direct Push tooling and sampling equipment were decontaminated using a non-phosphate soap wash followed by a potable water rinse and a deionized/distilled water rinse.

2.3.3 Field Health and Safety

The AOC investigation was performed in accordance to the North Wind Site Safety and Health Plan (North Wind, 2011b). Site control consisted of measures to prevent human exposure to hazardous materials at the site. No safety incidents or issues occurred during the field investigation.

2.3.4 Investigation Derived Waste Management

Field activities included the generation of investigation derived waste, including decontamination water, unused core, personal protective equipment (PPE) and disposable sampling equipment. Unused core was used to back fill the boring from which it was derived. Decontamination water was disposed of at the Facility WWTP. Disposable sampling equipment and PPE received a gross decontamination, if necessary, and was disposed of with the Facility waste.

3. PHYSICAL CHARACTERISTICS OF THE SITE

The physical characteristics of the Facility are described in the sections below.

3.1 Topography and Physiography

CPCPRC was constructed in 1966 on land previously graded and used for sugar cane cultivation. Elevations range from 45 ft above mean sea level (msl) at the northern portion of CPCPRC, to less than 5 ft msl at the southern boundary.

A manmade harbor, Las Mareas Harbor, was built about a half mile southwest of the main operation area to receive and ship products for CPCPRC. As part of the Facility decommissioning, the harbor area, including two ponds for the storage of ship ballast water (the Ballast Water Basins), underwent clean closure activities under RCRA with the supervision of EPA and PREQB. The Ballast Water Basins were clean closed in compliance with RCRA and other applicable legal requirements in 2010.

CPCPRC's lease to the harbor area has been terminated and the land is no longer part of the Facility.

3.2 Surface Water Features

During its operational period, surface water drainage across the CPCPRC facility entered one of five stormwater runoff collection or diversion systems (Phillips, 1999). Runoff then was either contained in the Storm Water Pond and/or the Final Holding Pond or entered one of several permitted National Pollutant Discharge Elimination System (NPDES) outfalls as described in the RFI Report (Phillips, 1999). Water that entered the Storm Water Pond and/or the Final Holding Pond was treated in the onsite WWTP.

As part of the final decommissioning, CPCPRC has re-routed the stormwater so that it no longer drains to the Storm Water Pond or Final Holding Pond. The ponds have been drained, sediment is being removed from the two ponds and the two ponds are currently being backfilled. All future stormwater from Facility will discharge in accordance with the Facilities Multi-sector General Permit for stormwater. The permitted stormwater discharge will be via outfalls that drain to the manmade earthen Effluent Channel located along the southern border of the Facility. The stormwater modifications are being performed in cooperation with and with the supervision of EPA and PREQB.

West of the CPCPRC property, CPCPRC's permitted discharge in the Effluent Channel commingles with discharges from Ayerst Wyeth Pharmaceuticals, In. (AWPI) and stormwater runoff from the surrounding area, and then ultimately discharges to the Caribbean Sea at Las Mareas Harbor.

3.3 Climate and Precipitation

The facility is set in a tropical area, with mean monthly temperatures above 64.4 degrees Fahrenheit, and a dry winter season. The mean annual precipitation in Guayama, located east of the facility, is 60 inches. Jobos, located west of the facility, receives an average of 45 inches of rain fall annually. The rainy season generally extends from May through November, with the dry season from December through April. On average, approximately 75% of the annual precipitation occurs during the rainy season.

3.4   Demographics and Land Use

In the past, the land surrounding the Facility was used mainly for sugar cane production. Currently, PRASA operates a WWTP east of the Facility and Advanced Energy System's (AES) coal-fired power plant operates directly to the west in the area previously referenced as the "West Cane field" in earlier reports. Several industrial facilities are located north of Highway 3 (approximately a half mile north of the facility). These include AWPI, Baxter and IPR Pharmaceutical Company and the former Fibers facility (a listed Superfund site). A Puerto Rico Department of Corrections facility is located directly northwest of the AWPI Plant and houses a population of approximately 600 inmates.

AP Industries, Inc. (formerly the location of SmithKline & Beecham Laboratories, as well as ChemSource, Inc.) is located near the northwest corner of the AES power plant property approximately a half mile west of the facility.

Similar to the CPCPRC site, the pre-construction topography of the AES area sloped to the south with elevations at about 24 ft above msl in the north and about 5 ft above msl at the southern property boundary. Construction of the AES coal-fired power plant began in November 1999 and included complete removal of all vegetation in the field to the west of CPCPRC (termed the West Cane Field in historical Facility reports). Following this site preparation work, AES transported, placed and compacted fill material. The fill was placed to raise and level the area and, therefore, more fill was placed in the southern portions of the facility than in the northern portions. Based on discussion with AES during January-February 2001, about 8 ft of fill was placed at the southern edge and little to no fill was placed along the northern edge of the property. Construction of the power facility was then started on the compacted and graded fill. Only a small portion of the AES property has remained undeveloped. This area runs along AES's southern fence line. The AES property is fenced and guarded 24-hours a day.

The town of Guayama, located northeast of the Facility, is the largest population center in the area. The population of the Guayama Municipio is approximately 42,000. The permanent population within a 2-mile radius of the facility is small and generally is employed by the industrial facilities surrounding CPCPRC, the government or the fishing industry.

In the mid-1960s, all the inhabitants of Las Mareas were relocated to the village of Barrancas, approximately 2 miles northeast. The population of Barrancas is approximately 4,500. Las Mareas subsequently was re-inhabited and approximately 30 to 35 small dwellings are currently occupied. To the north, is Colonia Reunion, a small community of approximately 4 to 5 small dwellings.

Based on current surrounding land use and likely expectations of future land use, the Facility will remain industrial.

3.5   Hydrogeology

The complete depiction of the subsurface environment beneath the Facility is provided in the RFI Report (Phillips, 1999). A brief overview of the hydrogeological system underlying the Facility is provided below:

- The base of the aquifer system beneath the Facility is identified as andesite bedrock and is typically found at about 80 ft bgs.

- Above the bedrock is the lower alluvial aquifer. The lower alluvial aquifer is present beneath the entire Facility and the top of the unit is typically observed at about 25 ft bgs. The aquifer materials consist primarily of fine-to-medium sand with some gravel. Groundwater flow in this aquifer is

generally to the south consistent with the regional gradient. Ultimately, groundwater in this aquifer discharges to the Caribbean Sea.

- Above the lower alluvial aquifer, a clay layer is typically found which forms a discontinuous aquitard between the lower and upper alluvial aquifers.

- The upper alluvial aquifer was deposited in an alluvial fan/transitional marine environment. As a result of this depositional environment, the aquifer materials consist of widely varying combinations of clay, silt, sand and gravel. Groundwater flow in this aquifer is to the east, south and west and flow and the orientation of the sand deposits exerts the primary control on groundwater flow. These sand channels have been mapped through the extensive characterization work performed during the RFI (over 400 borings drilled) and the AOC investigation (259 borings drilled). Based on RFI findings (Phillips, 1999), a small volume (about 2 to 4 gallons per minute [gpm]) of groundwater discharges to the Effluent Channel south of the Facility. Ultimately, the majority of the groundwater in this aquifer discharges to the Caribbean Sea.

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4. NATURE AND EXTENT OF CONTAMINATION

4.1 Summary of Analytical Data Evaluated

The data collected during the AOC investigations and during the May/June 2012 expanded semi-annual groundwater and effluent channel surface water and sediment sampling event comprise the data set used to define the nature and extent of contamination. These data are then used in the Human Health Risk Assessment (HHRA) and the Screening Level Ecological Risk Assessments (SLERA) presented in Section 6 of this report.

The analytical data are discussed in the sections below and are presented in tabular format on the included compact disk (CD). The results are presented individually for each of the 19 AOCs. For the surface soil data, Table 4-1 presents descriptive summary statistics of the data. The descriptive statistics are intended to facilitate an overall view of the data. Table 4-1 presents a summary of analytes detected in surface soil, the number of samples, number of detections, maximum detection and number detections that exceeded the risk-based screening levels (RBSLs). Table 4-2 presents a summary of analytes detected in subsurface soil, the number of samples, number of detections, maximum detection and number detections that exceeded the RBSLs. Tables 4-1 and 4-2 are then followed by detailed tables presenting all of the soil data (Tables 4-3 through 4-43). Similarly, the AOC groundwater data is summarized in Tables 4-44 through 4-63, and the expanded semi-annual sampling event groundwater data are presented in Tables 4-64 through 4-67, Tables 4-64 and 4-65 presents a summary of analytes detected in groundwater, the number of samples, number of detections, maximum detection and number detections that exceeded the RBSLs in groundwater. Table 4-65 is then followed by detailed tables presenting all of the groundwater data (Tables 4-66 through 4-67). Tables 4- 68 through 4-71 present the statistical summaries and the analytical data for the surface water and sediment samples.

4.1.1 Data Evaluation and Screening

In the nature and extent evaluation below, the analytical data are compared to the RBSLs. As described in detail in Section 6, the RBSLs are based on the site-specific exposure scenarios and site-specific environmental conditions.

The RBSLs were calculated based on the CSM of potential exposure for the four plausible receptor groups (resident, industrial worker, construction worker and trespasser). The media (surface soil, subsurface soil, groundwater, surface water and sediment) and pathways (ingestion, inhalation and dermal contact) were included in the calculations. In addition, the protection of groundwater from leaching of contaminants through the soil was considered. The lowest RBSL that would be protective of any receptor for each media was used for the data screening. The RBSL calculation methods are the same as those used in quantitative risk calculations and result in a conservative screening of the chemical data. The spreadsheets for the RBSLs for the plausible receptors and exposure pathways considered in the risk assessment, including the derivation of the groundwater protection concentrations, and the final lowest screening levels are presented in Appendix B. The final RBSLs are summarized in Table B-1.

The ecological screening levels for surface soil, surface water and sediment are presented in Table B-2.

4.1.2 Background Concentrations of Metals in Soil

Metals occur naturally in soil and therefore, it is important to understand if the metals levels detected in the site soil samples are naturally occurring or related to releases from the site processes. To discern between the naturally occurring and release-related concentrations, a comparison to background soil was performed. As mentioned previously, 10 background samples were collected during the AOC

investigation from areas unaffected by the site activities. The locations of the background soil samples are presented in Figure 4-1.

A total of 259 surface soil and 259 subsurface soil samples were collected from the 19 AOCs. From the perspective of exposure and risk assessment, a receptor may be exposed to soils from each of the AOCs with an equal probability. Considering this, the soil metals data from the AOCs were grouped together for a site-wide assessment. Three groups of data were assembled: 1) surface soil consisting of the 259 surface soil samples; 2) subsurface soil consisting of the 259 subsurface soil samples; and 3) combined soil consisting of a total of 518 samples (259 surface soil and 259 subsurface soil). These three datasets were statistically compared with the background dataset.

The statistical comparison was performed using the EPA's ProUCL Version 4.1 software. The software performs a variety of distribution tests on the site and the background datasets and calculates a probability or a "p" value using the two-sample Wilcoxon-Mann-Whitney test. All detected data, as well as nondetected data, were used in the comparison. The current version of ProUCL uses the nondetect values as reported and considers the range of reporting limits and the frequency of nondetects in calculating the ranks and test statistics.

The null hypothesis that the site mean concentration is less than the background mean concentration was used. The alternate hypothesis was that the site mean concentrations are greater than the background concentrations. In accordance with standard statistical testing, a critical value of 0.05 for "p" was used to signify the difference between the two datasets. If the "p" value was greater than 0.05, it can be concluded that the site mean value for a particular metal is statistically less than or equal to the background mean value for that metal.

The results of the statistical background comparisons are presented in Table 4-3 (surface soil), Table 4-4 (subsurface soil) and Table 4-5 (combined soil). As shown, the surface soil (Table 4-3) and subsurface soil (Table 4-4) statistics indicates that the metals cadmium, chromium, copper and nickel are statistically above the background in both media and zinc is above background in surface soil. Table 4-5 for the combined soil confirms that the five metals are above background. Based on this statistical testing, the remaining metals are at or below background levels.

The ProUCL output for each metal is presented in Appendix C.

4.2   Surface and Subsurface Soil Results

The following subsections present and discuss the analytical results for the surface soil and subsurface soil samples collected during the AOC investigation. The results are presented individually for each of the 19 AOCs. Tables 4-6 through 4-43 present all of the analytical results for soils at the 19 AOCs. Figures 4-2 through 4-20 present the boring locations for each AOC. The sitewide overview of the tanks and sampling locations are depicted in Figures 4-21 through 4-24.

4.2.1   Tank 10

Tank 10 was a 200-ft diameter tank that was used to store naphtha. The Tank 10 sampling design is displayed in Figure 4-2. Sampling conducted during the implementation of the SMP found that 2 of the 5 sampling locations contained exceedances of the screening levels. The exceedances were at the western and southern sample locations.

A 50-ft × 50-ft grid was established and a total of 17 surface soil and 17 subsurface soil samples were collected at Tank 10 including 16 planned locations and one step out location. A total of 18 borings were

drilled at Tank 10 including 16 for soil sampling only, 1 for soil and groundwater sampling, and 1 boring for groundwater sampling.

The analytical results for the soil samples are presented in Tables 4-6 and 4-7. A summary of the soil detections and the most significant RBSL exceedances at Tank 10 are presented below.

Surface Soil VOCs: Seven VOCs were detected in surface soil at Tank 10. The VOCs detected at Tank 10 were: 2-butanone (4 detections), acetone (7 detections), benzene (5 detections), ethylbenzene (5 detections), m & p-xylene (5 detections), o-xylene (4 detections), and toluene (2 detections). A total of 12 exceedances of the RBSLs were found at Tank 10. The exceedances were for benzene (5 exceedances), ethylbenzene (4 exceedances) and m & p-xylene (3 exceedances). The maximum concentrations detected were 720 µg/Kg, 330 µg/Kg, and 1,100 µg/Kg, respectively.

Subsurface Soil VOCs: Eight VOCs were detected in subsurface soil at Tank 10. The VOCs detected at Tank 10 were: 2-butanone (4 detections), acetone (16 detections), benzene (6 detections), carbon disulfide (3 detections), ethylbenzene (5 detections), m & p-xylene (5 detections), o-xylene (5), and toluene (4 detections). A total of 9 exceedances of the RBSLs were found at Tank 10. The exceedances were for benzene (6 exceedances), ethylbenzene (1 exceedance), m & p-xylene (1 exceedance) and o-xylene (1 exceedance). The maximum concentrations detected were 3,700 µg/Kg, 540 µg/Kg, 2,700 µg/Kg and 1,000 µg/Kg, respectively.

Surface Soil SVOCs: Only one SVOC was detected in surface soil at Tank 10. The detection was for sulfolane was detected at 440 µg/Kg and the detected value exceeded the RBSL. No other SVOCs were found at detectable levels.

Subsurface Soil SVOCs: Three SVOCs were detected in the subsurface soil at Tank 10. The detections were: 3 & 4 methylphenol (1 detection), naphthalene (1 detection), and phenol (1 detection). None of the detected constituents exceed their RBSL.

Surface Soil Metals: Eighteen metals were detected in surface soil at Tank 10. Fourteen of the detected metals were found at levels exceeding the RBSLs (Table 4-6); however, only three metals, cadmium, copper, and nickel were determined to be site-related based on the statistical background comparison.

Cadmium exceeded the RBSL in 16 of the 16 detections out of 17 samples (16 exceedances/16 detects/17 samples). Similarly the exceedances/detections/total samples statistics for copper are 17/17/17, and those for nickel are 3/17/17.

Subsurface Soil Metals: Seventeen metals were detected in subsurface soil at Tank 10. Fourteen of the detected constituents were found at levels exceeding the RBSLs (Table 4-7), however, only three metals, cadmium, copper and nickel were determined to be site-related based on the statistical background comparison.

Cadmium exceeded the RBSL in 16 of the 16 detections out of 17 samples (16 exceedances/16 detects/17 samples). Similarly the exceedances/detections/total samples statistics for copper are 17/17/17, and those for nickel are 1/17/17.

4.2.2   Tank 20

Tank 20 was a 200-ft diameter tank that was used to store naphtha. The Tank 20 sampling design is displayed in Figure 4-3. Sampling conducted during the implementation of the SMP found that 1 of the 5

sampling locations contained exceedances of the screening levels. The exceedance was at the western sample location.

A 50-ft × 50-ft grid was established and a total of 17 surface soil and 17 subsurface soil samples were collected at Tank 20 including 16 planned locations and one step out location. A total of 18 borings were drilled at Tank 20 including 16 for soil sampling only, 1 for soil and groundwater sampling, and 1 boring for groundwater sampling.

The analytical results for the soil samples are presented in Tables 4-8 and 4-9. A summary of the soil detections and the most significant RBSL exceedances at Tank 20 are presented below.

Surface Soil VOCs: Nine VOCs were detected in surface soil at Tank 20. The VOCs detected at Tank 20 were: acetone (3 detections), benzene (2 detections), carbon disulfide (1 detection), ethylbenzene (7 detections), methyl tert-butyl ether (2 detections), m & p-xylene (10 detections), o-xylene (9 detections), styrene (2 detections), and toluene (11 detections). A total of 18 exceedances of the RBSLs were found at Tank 20. The exceedances were for benzene (2 exceedances), ethylbenzene (5 exceedances), methyl tert-butyl ether (1 exceedance), m & p-xylene (5 exceedances), o-xylene (4 exceedances), and toluene (1 exceedance). The maximum concentrations detected were 210 µg/Kg, 6,800 µg/Kg, 5.2 µg/Kg, 39,000 µg/Kg, 13,000 µg/Kg, and 5,000 µg/Kg respectively.

Subsurface Soil VOCs: Ten VOCs were detected in subsurface soil at Tank 20. The VOCs detected at Tank 20 were: 1,2-dichloroethane (1 detection), 2-butanone (2 detections), acetone (4 detections), benzene (5 detections), ethylbenzene (8 detections), methyl tert-butyl ether (2 detections), m & p-xylene (10 detections), o-xylene (7 detections), styrene (3 detections), and toluene (6 detections). A total of 19 exceedances of the RBSLs were found at Tank 20. The exceedances were for 1,2-dichloroethane (1 exceedance), benzene (5 exceedances), ethylbenzene (7 exceedances), methyl tert-butyl ether (1 exceedance), m & p-xylene (3 exceedances), o-xylene (1 exceedance), and toluene (1 exceedance). The maximum concentrations detected were 3 µg/Kg, 240 µg/Kg, 6,500 µg/Kg, 15 µg/Kg, 36,000 µg/Kg, 15,000 µg/Kg, and 3,300 µg/Kg, respectively.

Surface Soil SVOCs: Seven SVOCs were detected in surface soil at Tank 20. The SVOCs detected at Tank 20 were: 2,4-dimethylphenol (1 detection), 2-methylphenol (1 detection), 3 & 4-methylphenol (1 detection), bis(2ethylhexyl) phthalate (1 detection), naphthalene (5 detections), phenol (1 detection) and sulfolane (2 detections). A total of 3 exceedances of the RBSLs were found at Tank 20. The exceedances were for bis(2ethylhexyl) phthalate (1 exceedance) and sulfolane (2 exceedances). The maximum concentrations detected were 880 µg/Kg and 7,600 µg/Kg, respectively.

Subsurface Soil SVOCs: Seven SVOCs were detected in subsurface soil at Tank 20. The SVOCs detected at Tank 20 were: 2,4-dimethylphenol (2 detections), 2-methylphenol (2 detections), 3 & 4-methylphenol (2 detections), bis(2ethylhexyl)phthalate (2 detections), naphthalene (2 detections), phenol (1 detection), and sulfolane (1 detection). Both bis(2ethylhexyl)phthalate and sulfolane exceeded the RBSLs once. The maximum concentrations detected were 200 µg/Kg and 14,000 µg/Kg, respectively.

Surface Soil Metals: Eighteen metals were detected in surface soil at Tank 20. Sixteen of the detected metals were found at levels exceeding the RBSLs (Table 4-8); however, only four metals, cadmium, copper, nickel, and zinc were determined to be site-related based on the statistical background comparison.

Cadmium exceeded the RBSL in 17 of the 17 detections out of 17 samples (17 exceedances/17 detects/17 samples). Similarly the exceedances/detections/total samples statistics for copper are 17/17/17, those for nickel are 4/17/17, and those for zinc are 2/17/17.

Subsurface Soil Metals: Eighteen metals were detected subsurface soil at Tank 20. Fourteen of the detected constituents were found at levels exceeding the RBSLs (Table 4-9); only two metals, cadmium and copper were determined to be site-related based on the statistical background comparison.

Cadmium exceeded the RBSL in 17 of the 17 detections out of 17 samples (17 exceedances/17 detects/17 samples). Similarly the exceedances/detections/total samples statistics for copper are 17/17/17.

4.2.3   Tank 41

Tank 41 was a 67-ft diameter tank that was used to store process water. The Tank 41 sampling design is displayed in Figure 4-4. Sampling conducted during the implementation of the SMP found that 1 of the 5 sampling locations contained exceedances of the screening levels. This exceedance was at the eastern sample location.

A 22-ft × 22-ft grid was established and a total of 12 surface soil and 12 subsurface soil samples were collected including 9 planned locations and 3 step out locations. A total of 13 borings were drilled at Tank 41 including 11 for soil sampling only, 1 for soil and groundwater sampling, and 1 boring for groundwater sampling.

The analytical results for the soil samples are presented in Tables 4-10 and 4-11. A summary of the soil detections and the most significant RBSL exceedances at Tank 41 are presented below.

Surface Soil VOCs: Seven VOCs were detected in surface at Tank 41. The VOCs detected at Tank 41 were: 2-butanone (2 detections), acetone (4 detections), benzene (3 detections), methyl tert-butyl ether (2 detections), m & p-xylene (6 detections), o-xylene (1 detection), and toluene (2 detections). A total of 6 exceedances of the RBSLs were found at Tank 41. The exceedances were for benzene (3 exceedances), methyl tert-butyl ether (1 exceedance), m & p-xylene (1 exceedance), and o-xylene (1 exceedance). The maximum concentrations detected were: 720 µg/Kg, 220 µg/Kg, 6,800 µg/Kg and 1,300 µg/Kg.

Subsurface Soil VOCs: Nine VOCs were detected in subsurface soil at Tank 41. The VOCs detected at Tank 41 were: 2-butanone (4 detections), acetone (9 detections), benzene (6 detections), carbon disulfide (1 detection), ethylbenzene (3 detections), methyl tert-butyl ether (2 detections), m & p-xylene (5 detections), o-xylene (4 detections),and toluene (2 detections). A total of 16 exceedances of the RBSLs were found at Tank 41. The exceedances were for acetone (2 exceedances), benzene (6 exceedances), ethylbenzene (2 exceedances), methyl tert-butyl ether (2 exceedances), m & p-xylene (2 exceedances) and toluene (2 exceedances). The maximum concentrations detected were: 22,000 µg/Kg, 6,000 µg/Kg, 250 µg/Kg, 96 µg/Kg, 1,700 µg/Kg and 10,000 µg/Kg, respectively.

Surface Soil SVOCs: One SVOC was detected in the surface soil sample at Tank 41. A single detection of 2,4-dimethylphenol was found at Tank 41. The detection did not exceed the RBSL.

Subsurface Soil SVOCs: Eight SVOCs were detected in subsurface soil at Tank 41.The SVOCs detected were: 2-methylphenol (1 detection), 3 & 4 methylphenol (1 detection), benzo(a)anthracene (1 detection), benzo(b)fluoranthene (1 detection), bis(2-ethylhexyl)phthalate (2 detections), di-n-butyl phthalate (1 detection), phenol (2 detections), and sulfolane (2 detections). A total of 6 exceedances of the RBSLs were found at Tank 41. The exceedances were for benzo(a)anthracene (1 exceedance), benzo(b)fluoranthene (1 exceedance), bis(2-ethylhexyl)phthalate (2 exceedances), and sulfolane (2 exceedances). The maximum concentrations detected were: 390 µg/Kg, 130 µg/Kg, 1,000 µg/Kg, and 80 µg/Kg, respectively.

Surface Soil Metals: Sixteen metals were detected in surface soil at Tank 41. Twelve of the detected metals were found at levels exceeding the RBSLs (Table 4-10); however, only three metals, cadmium, copper, and nickel were determined to be site-related based on the statistical background comparison.

Cadmium exceeded the RBSL in 8 of the 8 detections out of 12 samples (8 exceedances/8 detects/12 samples). Similarly the exceedances/detections/total samples statistics for copper are 12/12/12, and those for nickel are 3/12/12.

Subsurface Soil Metals: Seventeen metals were detected in subsurface soil at Tank 41. Thirteen of the detected constituents were found at levels exceeding the RBSLs (Table 4-11); however, only three metals, cadmium, copper, and nickel were determined to be site-related based on the statistical background comparison.

Cadmium exceeded the RBSL in 8 of the 8 detections out of 12 samples (8 exceedances/8 detects/12 samples). Similarly the exceedances/detections/total samples statistics for copper are 12/12/12, and those for nickel are 4/12/12.

4.2.4   Tank 42

Tank 42 was a 67-ft diameter tank that was used to store process water. The Tank 42 sampling design is displayed in Figure 4-5. Sampling conducted during the implementation of the SMP found that 5 of the 5 sampling locations contained exceedances of the screening levels. These locations were at the northern, southern, eastern, western, and center sample locations.

A 22-ft × 22-ft grid was established and a total of 13 surface soil and 13 subsurface soil samples were collected including 9 planned locations and 4 step out locations. A total of 14 borings were drilled at Tank 42 including 12 for soil sampling only, 1 for soil and groundwater sampling, and 1 boring for groundwater sampling.

The analytical results for the soil samples are presented in Tables 4-12 and 4-13. A summary of the soil detections and the most significant RBSL exceedances at Tank 42 are presented below.

Surface Soil VOCs: Seven VOCs were detected in surface soil at Tank 42. The VOCs detected at Tank 42 were: acetone (7 detections), benzene (7 detections), ethylbenzene (1 detection), methyl tert-butyl ether (2 detections), m & p-xylene (10 detections), o-xylene (3 detections), and toluene (9 detections). A total of 22 exceedances of the RBSLs were found at Tank 42. The exceedances were for acetone (5 exceedances), benzene (7 exceedances), ethylbenzene (1 exceedance), m & p-xylene (3 exceedances), o-xylene (1 exceedance) and toluene (5 exceedances). The maximum concentrations detected were: 41,000 µg/Kg, 10,000 µg/Kg, 1,100 µg/Kg, 3,700 µg/Kg, 960 µg/Kg and 26,000 µg/Kg, respectively.

Subsurface Soil VOCs: Ten VOCs were detected in subsurface soil at Tank 42. The VOCs detected at Tank 42 were: 1,2-dichloroethane (1 detection), 2-butanone (4 detections), acetone (11 detections), benzene (10 detections), carbon disulfide (1 detection), ethylbenzene (5 detections), methyl tert-butyl ether (1 detection), m & p-xylene (9 detections), o-xylene (6 detections), and toluene (9 detections).A total of 27 exceedances of the RBSLs were found at Tank 42. The exceedances were for 1,2-dichloroethane (1 exceedance), acetone (5 exceedances), benzene (10 exceedances), ethylbenzene (3 exceedances), m & p-xylene (3 exceedances), o-xylene (1 exceedance) and toluene (4 exceedances). The maximum concentrations detected were: 83 µg/Kg, 47,000 µg/Kg, 11,000 µg/Kg, 1,400 µg/Kg, 3,900 µg/Kg, 1,300 µg/Kg, and 21,000 µg/Kg, respectively.

Surface Soil SVOCs: Five SVOCs were detected in surface soil at Tank 42. The SVOCs detected at Tank 42 were: 2-methylphenol (3 detections), 3 & 4 methylphenol (1 detection), bis(2-ethylhexyl)phthalate (4 detections), di-n-butyl phthalate (2 detections), and phenol (3 detections). Only one exceedance of the RBSLs was found at Tank 42. The exceedance was for bis(2ethylhexyl)phthalate (1 exceedance). The maximum concentration detected was: 1,200 µg/Kg.

Subsurface Soil SVOCs: Five SVOCs were detected in subsurface soil at Tank 42. The SVOCs detected at Tank 42 were: 2-methylphenol (3 detections), 3 & 4 methylphenol (2 detections), bis(2-ethylhexyl)phthalate (3 detections), di-n-butyl phthalate (1 detection), and phenol (3 detections. A total of 2 exceedances of the RBSLs were found at Tank 42. The exceedances were for bis(2-ethylhexyl)phthalate (2 exceedances). The maximum concentration detected was: 180 µg/Kg.

Surface Soil Metals: Seventeen metals were detected in surface soil at Tank 42. Twelve of the detected metals were found at levels exceeding the RBSLs (Table 4-12); however, only three metals, cadmium, copper, and nickel were determined to be site-related based on the statistical background comparison.

Cadmium exceeded the RBSL in 8 of the 8 detections out of 13 samples (8 exceedances/8 detects/13 samples). Similarly the exceedances/detections/total samples statistics for copper are 13/13/13, and those for nickel are 4/13/13.

Subsurface Soil Metals: Seventeen metals were detected in subsurface soil at Tank 42. Thirteen of the detected constituents were found at levels exceeding the RBSLs (Table 4-13); however, only three metals, cadmium, copper, and nickel were determined to be site-related based on the statistical background comparison.

Cadmium exceeded the RBSL in 8 of the 8 detections out of 13 samples (8 exceedances/8 detects/13 samples). Similarly the exceedances/detections/total samples statistics for copper are 13/13/13, and those for nickel are 1/13/13.

4.2.5   Tank 80

Tank 80 was a 67-ft diameter tank that was used to store mixed xylenes. The Tank 87 sampling design is displayed in Figure 4-6. Sampling conducted during the implementation of the SMP found that 1 of the 5 sampling locations contained exceedances of the screening levels. This exceedance was at the center sample location.

A 22-ft × 22-ft grid was established and a total of 14 surface soil and 14 subsurface soil samples were collected including 9 planned locations and 5 step out locations. A total of 15 borings were drilled at Tank 80 including 13 for soil sampling only, 1 for soil and groundwater sampling, and 1 boring for groundwater sampling.

The analytical results for the soil samples are presented in Tables 4-14 and 4-15. A summary of the soil detections and the most significant RBSL exceedances at Tank 80 are presented below.

Surface Soil VOCs: Seven VOCs were detected in surface soil at Tank 80. The VOCs detected at Tank 80 were: 2-butanone (1 detection), acetone (6 detections), benzene (4 detections), ethylbenzene (6 detections), m & p-xylene (7 detections), o-xylene (3 detection), and styrene (1 detections). A total of 11 exceedances of the RBSLs were found at Tank 80. The exceedances were for benzene (4 exceedances), ethylbenzene (4 exceedances), m & p-xylene (1 exceedance), o-xylene (1 exceedance), and styrene (1 exceedance). The maximum concentrations detected were: 1,900 µg/Kg, 710,000 µg/Kg, 5,700,000 µg/Kg, 590,000 µg/Kg, and 18,000 µg/Kg, respectively.

Subsurface Soil VOCs: Six VOCs were detected in subsurface soil at Tank 80. The VOCs detected at Tank 80 were: 2-butanone (1 detection), acetone (6 detections), benzene (7 detections), ethylbenzene (11 detections), m & p-xylene (12 detections), and o-xylene (7 detections). A total of 20 exceedances of the RBSLs were found at Tank 80. The exceedances were for benzene (7 exceedances), ethylbenzene (7 exceedances), m & p-xylene (5 exceedances), and o-xylene (1 exceedance). The maximum concentrations detected were: 4,300 µg/Kg, 13,000 µg/Kg, 83,000 µg/Kg, and 7,800 µg/Kg, respectively.

Surface Soil SVOCs: Four SVOCs were detected in surface soil at Tank 80. The SVOCs detected at Tank 80 were: 2,4-dimethylphenol (1 detection), bis(2-ethylhexyl)phthalate (1 detection), phenol (1 detection), and sulfolane (1 detection). A total of two exceedances of the RBSLs were found at Tank 80. The exceedances were for bis(2-ethylhexyl)phthalate (1 exceedance) and sulfolane (1 exceedance). The maximum concentrations detected were: 840 µg/Kg and 190 µg/Kg, respectively.

Subsurface Soil SVOCs: Eleven SVOCs were detected in subsurface soil at Tank 80. The SVOCs detected were: 2,4-dimethylphenol (3 detections), 7,12-dimethylbenz(a)anthracene (1 detection), benzo(a)pyrene (1 detection), bis(2-ethylhexyl)phthalate (5 detections), chrysene (1 detection), di-n-butyl phthalate (1 detection), fluoranthene (1 detection), indeno(1,2,3-cd)pyrene (1 detection), naphthalene (1 detection), phenol (2 detections), and pyrene (1 detection). A total of 6 exceedances of the RBSLs were found at Tank 80. The exceedances were for 7,12-dimethylbenz(a)anthracene (1 exceedance), benzo(a)pyrene (1 exceedance), bis(2-ethylhexyl)phthalate (3 exceedances), and indeno(1,2,3-cd)pyrene (1 exceedance). The maximum concentrations detected were: 63 µg/Kg, 120 µg/Kg, 11,000 µg/Kg, and 57 µg/Kg, respectively.

Surface Soil Metals: Seventeen metals were detected in surface soil at Tank 80. Twelve of the detected metals were found at levels exceeding the RBSLs (Table 4-14); however, only three metals, cadmium, copper, and nickel were determined to be site-related based on the statistical background comparison.

Cadmium exceeded the RBSL in 8 of the 8 detections out of 14 samples (8 exceedances/8 detects/14 samples). Similarly the exceedances/detections/total samples statistics for copper are 14/14/14, and those for nickel are 2/14/14.

Subsurface Soil Metals: Seventeen metals were detected in subsurface soil at Tank 80. Ten of the detected constituents were found at levels exceeding the RBSLs (Table 4-15); however, only two metals, cadmium and copper were determined to be site-related based on the statistical background comparison.

Cadmium exceeded the RBSL in 8 of the 8 detections out of 14 samples (8 exceedances/8 detects/14 samples). Similarly the exceedances/detections/total samples statistics for copper are 14/14/14.

4.2.6   Tank 100

Tank 100 was a 119-ft diameter tank that was used to store diesel range organic (C9+). The Tank 100 sampling design is displayed in Figure 4-7. Sampling conducted during the implementation of the SMP found that 3 of the 5 sampling locations contained exceedances of the screening levels. These exceedances were at the northern, southern, and western sample locations.

A 40-ft × 40-ft grid was established, generating 10 sample locations. Surface soil and subsurface soil samples were collected at each of the 10 locations. A total of 10 borings were drilled at Tank 100 including 8 for soil sampling and 2 for soil and groundwater sampling.

The analytical results for the soil samples are presented in Tables 4-16 and 4-17. A summary of the soil detections and the most significant RBSL exceedances at Tank 80 are presented below.

Surface Soil VOCs: Eight VOCs were detected in surface soil at Tank 100. The VOCs detected at Tank 100 were: 2-butanone (5 detections), acetone (5 detections), benzene (5 detections), ethylbenzene (3 detections), methyl tert-butyl ether (1 detection), m & p-xylene (5 detections), o-xylene (4 detections), and toluene (2 detections). A total of 6 exceedances of the RBSLs were found at Tank 100. The exceedances were for benzene (5 exceedances) and ethylbenzene (1 exceedance). The maximum concentrations detected were: 1,000 µg/Kg, and 16 µg/Kg, respectively.

Subsurface Soil VOCs: Nine VOCs were detected in subsurface soil at Tank 100. The VOCs detected at Tank 100 were: 2-butanone (5 detections), acetone (7 detections), benzene (6 detections), ethylbenzene (4 detections), methyl tert-butyl ether (1 detection), m & p-xylene (9 detections), o-xylene (6 detections), styrene (1 detection), and toluene (4 detections). A total of 12 exceedances of the RBSLs were found at Tank 100. The exceedances were for benzene (6 exceedances), ethylbenzene (3 exceedances), m & p-xylene (2 exceedances) and o-xylene (1 exceedance). The maximum concentrations detected were: 380 µg/Kg, 480 µg/Kg, 1,300 µg/Kg and 1,200 µg/Kg, respectively.

Surface Soil SVOCs: Two SVOCs were detected in surface soil at Tank 100. The SVOCs detected at Tank 100 were: bis(2-ethylhexyl)phthalate (2 detections) and phenol (1 detection). Only one exceedance of the RBSLs was found at Tank 100. The exceedance was for bis(2-ethylhexyl)phthalate (1 exceedance). The maximum concentration detected was 100 µg/Kg.

Subsurface Soil SVOCs: Four SVOCs were detected in subsurface soil at Tank 100. The SVOCs detected were: 3 & 4 methylphenol (1 detection), bis(2-ethylhexyl)phthalate (1 detection), phenol (1 detection) and sulfolane (1 detection). A total of 2 exceedances were found at Tank 100. The exceedances were for bis(2-ethylhexyl)phthalate (1exceedance) and sulfolane (1 exceedance). The maximum detected concentrations were: 220 µg/Kg and 69 µg/Kg, respectively.

Surface Soil Metals: Seventeen metals were detected in surface soil at Tank 100. Twelve of the detected metals were found at levels exceeding the RBSLs (Table 4-16); however, only three metals, cadmium, copper, and nickel were determined to be site-related based on the statistical background comparison.

Cadmium exceeded the RBSL in 10 of the 10 detections out of 10 samples (10 exceedances/10 detects/10 samples). Similarly the exceedances/detections/total samples statistics for copper are 10/10/10, and those for nickel are 1/10/10.

Subsurface Soil Metals: Eighteen metals were detected in subsurface soil at Tank 100. Twelve of the detected constituents were found at levels exceeding the RBSLs (Table 4-17); however, only two metals, cadmium and copper were determined to be site-related based on the statistical background comparison.

Cadmium exceeded the RBSL in 10 of the 10 detections out of 10 samples (10 exceedances/10 detects/10 samples). Similarly the exceedances/detections/total samples statistics for copper are 10/10/10.

4.2.7   Tank 160

Tank 160 was a 180-ft diameter tank that was used to store blend stocks. The Tank 160 sampling design is displayed in Figure 4-8. Sampling conducted during the implementation of the SMP found that 1 of the 5 sampling locations contained exceedances of the screening levels. The exceedance was at the center sample location.

A 45-ft × 45-ft grid was established, generating 16 sample locations. Surface soil and subsurface soil samples were collected at each of the 16 locations. A total of 17 borings were drilled at Tank 160 including 15 for soil sampling, 1 for soil and groundwater sampling, and 1 for groundwater sampling.

The analytical results for the soil samples are presented in Tables 4-18 and 4-19. A summary of the detections and the most significant RBSL exceedances at Tank 160 are presented below.

Surface Soil VOCs: Eight VOCs were detected in surface soil at Tank 160. The VOCs detected at Tank 160 were: 2-butanone (4 detections), acetone (8 detections), benzene (11 detections), ethylbenzene (1 detection), methyl tert-butyl ether (3 detections), m & p-xylene (7 detections), o-xylene (2 detections), and toluene (5 detections). A total of 14 exceedances of the RBSLs were found at Tank 160. The exceedances were for benzene (11 exceedances), ethylbenzene (1 exceedance), and m & p-xylene (2 exceedances). The maximum concentrations detected were: 10,000 µg/Kg, 120 µg/Kg, and 1,500 µg/Kg, respectively.

Subsurface Soil VOCs: Eight VOCs were detected in subsurface soil at Tank 160. The VOCs detected at Tank 160 were: 2-butanone (1 detection), acetone (3 detections), benzene (14 detections), ethylbenzene (12 detections), methyl tert-butyl ether (1 detection), m & p-xylene (14 detections), o-xylene (13 detections), and toluene (10 detections). A total of 34 exceedances of the RBSLs were found at Tank 160. The exceedances were for benzene (14 exceedances), ethylbenzene (9 exceedances), m & p-xylene (9 exceedances) and o-xylene (2 exceedances). The maximum concentrations detected were: 6,800 µg/Kg, 410 µg/Kg, 6,900 µg/Kg and 1,500 µg/Kg, respectively.

Surface Soil SVOCs: Three SVOCs were detected in surface soil at Tank 160. The SVOCs detected at Tank 160 were: bis(2-ethylhexyl)phthalate (1 detection), phenol (1 detection), and sulfolane (1 detection). A total of 2 exceedances were found at Tank 160. The exceedances were for bis(2-ethylhexyl)phthalate (1 exceedance) and sulfolane (1 exceedance). The maximum concentrations detected were: 130 µg/Kg, 210 µg/Kg, respectively.

Subsurface Soil SVOCs: Six SVOCs were detected in subsurface soil at Tank 160. The SVOCs detected were: 3 & 4 methylphenol (1 detection), bis(2-ethylhexyl)phthalate (2 detections), di-n-octyl phthalate (1 detection), naphthalene (1 detection), phenol (11 detections), and sulfolane (2 detections). A total of three exceedances of the RBSLs were found at Tank 160. The exceedances were for bis(2-ethylhexyl)phthalate (1 exceedance) and sulfolane (2 exceedances). The maximum concentrations detected were: 92 µg/Kg and 390 µg/Kg, respectively.

Surface Soil Metals: Eighteen metals were detected in surface soil at Tank 160. Eleven of the detected metals were found at levels exceeding the RBSLs (Table 4-18); however, only two metals, cadmium and copper were determined to be site-related based on the statistical background comparison.

Cadmium exceeded the RBSL in 16 of the 16 detections out of 16 samples (16 exceedances/16 detects/16 samples). Similarly the exceedances/detections/total samples statistics for copper are 16/16/16.

Subsurface Soil Metals: Eighteen metals were detected in subsurface soil at Tank 160. Eleven of the detected constituents were found at levels exceeding the RBSLs (Table 4-19); however, only two metals, cadmium and copper were determined to be site-related based on the statistical background comparison.

Cadmium exceeded the RBSL in 16 of the 16 detections out of 16 samples (16 exceedances/16 detects/16 samples). Similarly the exceedances/detections/total samples statistics for copper are 16/16/16.

4.2.8   Tank 170

Tank 170 was a 173-ft diameter tank that was used to store finished gasoline. The Tank 170 sampling design is displayed in Figure 4-9. Sampling conducted during the implementation of the SMP found that

3 of the 5 sampling locations contained exceedances of the screening levels. The exceedances were at the northern, southern, and center sample locations.

A 43-ft × 43-ft grid was established, generating 16 sample locations. Surface soil and subsurface soil samples were collected at each of the 16 locations. A total of 16 borings were drilled at Tank 170 including 14 for soil sampling and 2 for soil and groundwater sampling.

The analytical results for the surface soil and subsurface soil samples are presented in Tables 4-20 and 4-21. A summary of the detections and the most significant RBSL exceedances at Tank 170 are presented below.

Surface Soil VOCs: Nine VOCs were detected in surface soil at Tank 170. The VOCs detected at Tank 170 were: 2-butanone (4 detections), acetone (7 detections), benzene (9 detections), ethylbenzene (8 detections), methyl tert-butyl ether (5 detections), m & p-xylene (11 detections), o-xylene (9 detections), styrene (7 detections), and toluene (10 detections). A total of 41 exceedances of the RBSLs were found at Tank 170. The exceedances were for acetone (2 exceedances), benzene (9 exceedances), ethylbenzene (8 exceedances), methyl tert-butyl ether (3 exceedances), m & p-xylene (6 exceedances), o-xylene (6 exceedances), styrene (1 exceedance), and toluene (6 exceedances). The maximum concentrations detected were: 39,000 µg/Kg, 12,000 µg/Kg, 480,000 µg/Kg, 76 µg/Kg, 630,000 µg/Kg, 790,000 µg/Kg, 24,000 µg/Kg, and 57,000 µg/Kg, respectively.

Subsurface Soil VOCs: Ten VOCs were detected subsurface soil at Tank 170. The VOCs detected at Tank 170 were: 2-butanone (6 detections), acetone (9 detections), benzene (10 detections), carbon disulfide (4 detections), ethylbenzene (13 detections), methyl tert-butyl ether (6 detections), m & p-xylene (14 detections), o-xylene (12 detections), styrene (5 detections), and toluene (10 detections). A total of 38 exceedances of the RBSLs were found at Tank 170. The exceedances were for acetone (1 exceedances), benzene (10 exceedances), ethylbenzene (11 exceedances), methyl tert-butyl ether (4 exceedances), m & p-xylene (7 exceedances), o-xylene (3 exceedances), and toluene (2 exceedances). The maximum concentrations detected were: 24,000 µg/Kg, 1,600 µg/Kg, 25,000 µg/Kg, 260 µg/Kg, 120,000 µg/Kg, 49,000 µg/Kg, and 54,000 µg/Kg, respectively.

Surface Soil SVOCs: Nine SVOCs were detected in surface soil at Tank 170. The SVOCs detected at Tank 170 were: 2-methylphenol (2 detections), 3 & 4 methylphenol (3 detections), bis(2-ethylhexyl)phthalate (4 detections), di-n-butyl phthalate (3 detections), fluoranthene (1 detection). naphthalene (7 detections), phenol (5 detections), pyrene (1 detection), and sulfolane (5 detections). A total of 15 exceedances of the RBSLs were found at Tank 170. The exceedances were for bis(2ethylhexyl)phthalate (4 exceedances), naphthalene (6 exceedances), and sulfolane (5 exceedances). The maximum concentrations detected were: 6,500 µg/Kg, 4,200 µg/Kg, and 2,200 µg/Kg, respectively.

Subsurface Soil SVOCs: Nineteen SVOCs were detected in subsurface soil at Tank 170. The SVOCs detected were: 2,4-dimethylphenol (2 detections), 2-methylphenol (3 detections), 3 &4 methylphenol (5 detections), acenaphthene (2 detections), anthracene (1 detection), benzo(a)anthracene (1 detection), benzo(a)pyrene (1 detection), benzo(b)fluoranthene (1 detection), bis(2-ethylhexyl)phthalate (5 detections), chrysene (1 detection), di-n-butyl phthalate (1 detection), fluoranthene (3 detections), fluorene (2 detections), indeno(1,2,3-cd)pyrene (1 detection), naphthalene (4 detections), nitrobenzene (1 detection), phenol (7 detections), pyrene (3 detections), and sulfolane (5 detections). A total of 17 exceedances of the RBSLs were found at Tank 170. The exceedances were for: benzo(a)anthracene (1 exceedance), benzo(a)pyrene (1 exceedance), benzo(b)fluoranthene (1 exceedance), bis(2-ethylhexyl)phthalate (4 exceedances), indeno(1,2,3-cd)pyrene (1 exceedance), naphthalene (3 exceedances), nitrobenzene (1 exceedance), and sulfolane (5 exceedances). The maximum concentrations

detected were: 610 µg/Kg, 400 µg/Kg, 390 µg/Kg, 13,000 µg/Kg, 180 µg/Kg, 7,400 µg/Kg, 1,500 µg/Kg, and 5,000 µg/Kg, respectively.

Surface Soil Metals: Eighteen metals were detected in surface soil at Tank 170. Thirteen of the detected metals were found at levels exceeding the RBSLs (Table 4-20); however, only three metals, cadmium, copper, and nickel were determined to be site-related based on the statistical background comparison.

Cadmium exceeded the RBSL in 16 of the 16 detections out of 16 samples (16 exceedances/16 detects/16 samples). Similarly the exceedances/detections/total samples statistics for copper are 16/16/16, and those for nickel are 1/16/16.

Subsurface Soil Metals: Seventeen metals were detected in subsurface soil at Tank 170. Eleven of the detected constituents were found at levels exceeding the RBSLs (Table 4-21); however, only two metals, cadmium and copper were determined to be site-related based on the statistical background comparison.

Cadmium exceeded the RBSL in 16 of the 16 detections out of 16 samples (16 exceedances/16 detects/16 samples). Similarly the exceedances/detections/total samples statistics for copper are 16/16/16.

4.2.9 Tank 220

Tank 220 was a 200-ft diameter tank that was used to store cyclohexane. The Tank 220 sampling design is displayed in Figure 4-10. Sampling conducted during the implementation of the SMP found that 1 of the 5 sampling locations contained exceedances of the screening levels. The exceedance was at the western sample location.

A 50-ft × 50-ft grid was established, generating 16 sample locations. Surface soil and subsurface soil samples were collected at each of the 16 locations. A total of 17 borings were drilled at Tank 220 including 15 for soil sampling, 1 for soil and groundwater sampling, and 1 for groundwater sampling.

The analytical results for the surface soil and subsurface soil samples are presented in Tables 4-22 and 4-23. A summary of the detections and the most significant RBSL exceedances at Tank 220 are presented below.

Surface Soil VOCs: Six VOCs were detected in surface soil at Tank 220. The VOCs detected at Tank 220 were: acetone (4 detections), benzene (2 detections), ethylbenzene (3 detections), m & p-xylene (7 detections), o-xylene (3 detections), and toluene (7 detections). A total of 11 exceedances of the RBSLs were found at Tank 220. The exceedances were for: benzene (2 exceedances), ethylbenzene (3 exceedances), m & p-xylene (3 exceedance), o-xylene (2 exceedances) and toluene (1 exceedance). The maximum concentrations detected were: 680 µg/Kg, 2,000 µg/Kg, 8,000 µg/Kg, 2,700 µg/Kg and 31,000 µg/Kg, respectively.

Subsurface Soil VOCs: Six VOCs were detected in subsurface soil at Tank 220. The VOCs detected at Tank 220 were: 2-butanone (1 detection), acetone (4 detections), ethylbenzene (2 detections), m &p-xylene (5 detections), o-xylene (3 detections), and toluene (4 detections). A total of 4 exceedances of the RBSLs were found at Tank 220. The exceedances were for ethylbenzene (2 exceedances) and m & p-xylene (2 exceedances). The maximum concentrations detected were: 290 µg/Kg and 1,600 µg/Kg, respectively.

Surface Soil SVOCs: Six SVOCs were detected in surface soil at Tank 220. The SVOCs detected at Tank 220 were: 2,4-dimethylphenol (1 detection), 2-methylphenol (1 detection), 3 & 4 methylphenol (1 detection), bis(2-ethylhexyl)phthalate (1 detection), fluorene (1 detection), and naphthalene (1 detection).

Only one exceedance of the RBSLs was found at Tank 220. The exceedance was for bis(2-ethylhexyl)phthalate (1 exceedance). The maximum concentration detected was: 70 µg/Kg.

Subsurface Soil SVOCs: No SVOCs were detected in subsurface soil samples at Tank 220.

Surface Soil Metals: Eighteen metals were detected in surface soil at Tank 220. Fourteen of the detected metals were found at levels exceeding the RBSLs (Table 4-22); however, only three metals, cadmium, copper, and nickel were determined to be site-related based on the statistical background comparison.

Cadmium exceeded the RBSL in 16 of the 16 detections out of 16 samples (16 exceedances/16 detects/16 samples). Similarly the exceedances/detections/total samples statistics for copper are 16/16/16, and those for nickel are 2/16/16.

Subsurface Soil Metals: Seventeen metals were detected in subsurface soil at Tank 220. Ten of the detected constituents were found at levels exceeding the RBSLs (Table 4-23); however, only two metals, cadmium and copper were determined to be site-related based on the statistical background comparison.

Cadmium exceeded the RBSL in 16 of the 16 detections out of 16 samples (16 exceedances/16 detects/16 samples). Similarly the exceedances/detections/total samples statistics for copper are 16/16/16.

4.2.10 Tank 240

Tank 240 was a 36-ft diameter tank that was used to store benzene mix. The Tank 220 sampling design is displayed in Figure 4-11. Sampling conducted during the implementation of the SMP found that 3 of the 5 sampling locations contained exceedances of the screening levels. The exceedances were at the northern, eastern, and center sample locations.

A 12-ft × 12-ft grid was established and a total of 13 surface soil and 13 subsurface soil samples were collected at Tank 240 including 9 planned locations and 4 step out locations. A total of 13 borings were drilled at Tank 240 including 11 for soil sampling and 2 for soil and groundwater sampling.

The analytical results for the soil samples are presented in Tables 4-24 and 4-25. A summary of the detections and the most significant RBSL exceedances at Tank 240 are presented below.

Surface Soil VOCs: Five VOCs were detected in surface soil at Tank 240. The VOCs detected at Tank 240 were: 2-butanone (1 detection), acetone (5 detections), benzene (5 detections), ethylbenzene (1 detection), and m & p-xylene (4 detections). A total of five exceedances of the RBSLs were found at Tank 240. The exceedances were for benzene. The maximum concentration detected was: 8.1 µg/Kg.

Subsurface Soil VOCs: Six VOCs were detected in subsurface soil at Tank 240. The VOCs detected at Tank 240 were: 2-butanone (3 detections), acetone (10 detections), benzene (8 detections), carbon disulfide (3 detections), ethylbenzene (6 detections), and m & p-xylene (7 detections). A total of 8 exceedances of the RBSLs were found at Tank 240. The exceedances were for benzene. The maximum concentration detected was: 3,100 µg/Kg.

Surface Soil SVOCs: No SVOCs were detected in the surface soil samples at Tank 240.

Subsurface Soil SVOCs: One SVOC was detected in subsurface soil sample at Tank 240. A single detection of phenol was found at Tank 240. The detection did not exceed the RBSL.

Surface Soil Metals: Seventeen metals were detected in surface soil at Tank 240. Thirteen of the detected metals were found at levels exceeding the RBSLs (Table 4-24); however, only three metals, cadmium, copper, and nickel were determined to be site-related based on the statistical background comparison.

Cadmium exceeded the RBSL in 8 of the 8 detections out of 13 samples (8 exceedances/8 detects/13 samples). Similarly the exceedances/detections/total samples statistics for copper are 13/13/13, and those for nickel are 1/13/13.

Subsurface Soil Metals: Sixteen metals were detected in subsurface soil at Tank 240. Ten of the detected constituents were found at levels exceeding the RBSLs (Table 4-25); however, only two metals, cadmium and copper were determined to be site-related based on the statistical background comparison.

Cadmium exceeded the RBSL in 8 of the 8 detections out of 13 samples (8 exceedances/8 detects/13 samples). Similarly the exceedances/detections/total samples statistics for copper are 13/13/13.

4.2.11   Tank 330

Tank 330 was a 100-ft diameter tank that was used to store cyclohexane. The Tank 330 sampling design is displayed in Figure 4-12. Sampling conducted during the implementation of the SMP found that 3 of the 5 sampling locations contained exceedances of the screening levels. The exceedances were at the southern, western, and center sample locations.

A 33-ft × 33-ft grid was established and a total of 12 surface soil and 12 subsurface soil samples were collected at Tank 330 including 9 planned locations and 3 step out locations. A total of 12 borings were drilled at Tank 330 including 10 for soil sampling and 2 for soil and groundwater sampling.

The analytical results for the soil samples are presented in Tables 4-26 and 4-27. A summary of the soil detections and the most significant RBSL exceedances at Tank 330 are presented below.

Surface Soil VOCs: Seven VOCs were detected in surface soil at Tank 330. The VOCs detected at Tank 330 were: 2-butanone (2 detections), acetone (5 detections), benzene (3 detections), ethylbenzene (1 detection), methyl tert-butyl ether (1 detection), m & p-xylene (1 detection), and o-xylene (1 detection). A total of 3 exceedances of the RBSLs were found at Tank 330. The exceedances were for benzene. The maximum concentration detected was: 57µg/Kg.

Subsurface Soil VOCs: Nine VOCs were detected in subsurface soil at Tank 330. The VOCs detected at Tank 330 were: 2-butanone (7 detections), acetone (7 detections), benzene (8 detections), carbon disulfide (3 detections), ethylbenzene (7 detections), methyl tert-butyl ether (3 detections), m & p-xylene (8 detections), o-xylene (7 detections), and toluene (5 detections). A total of 9 exceedances of the RBSLs were found at Tank 330. The exceedances were for benzene (8 exceedances) and ethylbenzene (1 exceedance). The maximum concentrations detected were: 260 µg/Kg, and 14 µg/Kg, respectively.

Surface Soil SVOCs: Two SVOCs were detected in surface soil at Tank 330. The SVOCs detected at Tank 330 were: 2,4-dimethylphenol (1 detection) and sulfolane (1 detection). The single sulfolane detection at a concentration of 40 µg/Kg exceeded the RBSL.

Subsurface Soil SVOCs: Two SVOCs were detected in subsurface soil at Tank 330. The SVOCs detected at Tank 330 were: bis(2-ethylhexyl) phthalate (1 detection) and sulfolane (2 detections). A total of three exceedances of the RBSL were found at Tank 330. The exceedances were for bis(2-ethylhexyl) phthalate (1 exceedance) and sulfolane (2 exceedances). The maximum concentrations detected were 140 µg/Kg and 230 µg/Kg, respectively.

Surface Soil Metals: Seventeen metals were detected in surface soil at Tank 330. Thirteen of the detected metals were found at levels exceeding the RBSLs (Table 4-26); however, only three metals, cadmium, copper, and nickel were determined to be site-related based on the statistical background comparison.

Cadmium exceeded the RBSL in 8 of the 8 detections out of 12 samples (8 exceedances/8 detects/12 samples). Similarly the exceedances/detections/total samples statistics for copper are 12/12/12, and those for nickel are 2/12/12.

Subsurface Soil Metals: Sixteen metals were detected in subsurface soil at Tank 330. Eleven of the detected constituents were found at levels exceeding the RBSLs (Table 4-27); however, only two metals, cadmium and copper were determined to be site-related based on the statistical background comparison.

Cadmium exceeded the RBSL in 8 of the 8 detections out of 12 samples (8 exceedances/8 detects/12 samples). Similarly the exceedances/detections/total samples statistics for copper are 12/12/12.

4.2.12   Tank 340

Tank 340 was a 110-ft diameter tank that was used to store diesel. The Tank 340 sampling is displayed in Figure 4-13. Sampling conducted during the implementation of the SMP found that 1 of the 5 sampling locations contained exceedances of the screening levels. The exceedance was at the northern sample location.

A 37-ft × 37-ft grid was established and a total of 10 surface soil and 10 subsurface soil sampled were collected including 9 planned locations and 1 step out location. A total of 10 borings were drilled at Tank 340 including 8 for soil sampling and 2 for soil and groundwater sampling.

The analytical results for the soil samples are presented in Tables 4-28 and 4-29. A summary of the detections and the most significant RBSL exceedances at Tank 340 are presented below.

Surface Soil VOCs: Seven VOCs were detected in surface soil at Tank 340. The VOCs detected at Tank 340 were: 2-butanone (2 detections), acetone (4 detections), benzene (3 detections), methyl tert-butyl ether (1 detection), m & p-xylene (2 detections), o-xylene (1 detection), and toluene (1 detection). A total of 4 exceedances of the RBSLs were found at Tank 340. The exceedances were for benzene (3 exceedances) and methyl tert-butyl ether (1exceedance). The maximum concentrations detected were 830 µg/Kg and 4.2 µg/Kg, respectively.

Subsurface Soil VOCs: Eight VOCs were detected in subsurface soil at Tank 340. The VOCs detected at Tank 340 were: 2-butanone (3 detections), acetone (4 detections), benzene (7 detections), carbon disulfide (1 detection), ethylbenzene (5 detections), m & p-xylene (7 detections), o-xylene (7 detections), and toluene (2 detections). A total of 14 exceedances of the RBSLs were found at Tank 340. The exceedances were for benzene (7 exceedances), ethylbenzene (4 exceedances) and m & p-xylene (3 exceedances). The maximum concentrations detected were 2,100 µg/Kg, 240 µg/Kg and 4,200 µg/Kg, respectively.

Surface Soil SVOCs: One SVOC was detected in the surface soil sample at Tank 340. The SVOC detected at Tank 340 was: phenol (1 detection). The detection did not exceed the RBSL.

Subsurface Soil SVOCs: Two SVOCs were detected in the surface soil sample at Tank 340. The SVOCs detected at Tank 340 were: bis(2-ethylhexyl)phthalate (1 detection) and phenol (2 detections). None of the detections exceeded the RBSLs.

Surface Soil Metals: Eighteen metals were detected in surface soil at Tank 340. Thirteen of the detected metals were found at levels exceeding the RBSLs (Table 4-28); however, only three metals, cadmium, copper, and nickel were determined to be site-related based on the statistical background comparison.

Cadmium exceeded the RBSL in 7 of the 7 detections out of 10 samples (7 exceedances/7 detects/10 samples). Similarly the exceedances/detections/total samples statistics for copper are 10/10/10, and those for nickel are 1/10/10.

Subsurface Soil Metals: Seventeen metals were detected in subsurface soil at Tank 340. Ten of the detected constituents were found at levels exceeding the RBSLs (Table 4-29); however, only two metals, cadmium and copper were determined to be site-related based on the statistical background comparison.

Cadmium exceeded the RBSL in 7 of the 7 detections out of 10 samples (7 exceedances/7 detects/10 samples). Similarly the exceedances/detections/total samples statistics for copper are 10/10/10.

4.2.13   Tank 360

Tank 360 was a 212-ft diameter tank that was used to store naphtha. The Tank 360 sampling design is displayed in Figure 4-14. Sampling conducted during the implementation of the SMP found that 4 of the 6 sampling locations contained exceedances of the screening levels. These exceedances were at the southern, eastern and two center sample locations.

A 53-ft × 53-ft grid was established and a total of 17 surface soil and 17 subsurface soil samples were collected including 16 planned locations and 1 step out location. A total of 18 borings were drilled at Tank 360 including 16 for soil sampling, 1 for soil and groundwater sampling, and 1 for groundwater sampling.

The analytical results for the soil samples are presented in Tables 4-30 and 4-31. A summary of the detections and the most significant RBSL exceedances at Tank 360 are presented below.

Surface Soil VOCs: Seven VOCs were detected in surface soil at Tank 360. The VOCs detected at Tank 360 were: 2-butanone (1 detection), acetone (3 detections), benzene (10 detections), ethylbenzene (10 detections), m & p-xylene (10 detections), o-xylene (10 detections), and toluene (9 detections). A total of 38 exceedances of the RBSLs were found at Tank 360. The exceedances were for benzene (10 exceedances), ethylbenzene (10 exceedances), m & p-xylene (7 exceedances), o-xylene (7 exceedances), and toluene (4 exceedances). The maximum concentrations detected were: 8,100 µg/Kg, 7,300/Kg, 31,000 µg/Kg, 17,000 µg/Kg, and 29,000 µg/Kg, respectively.

Subsurface Soil VOCs: Ten VOCs were detected in subsurface soil at Tank 360. The VOCs detected at Tank 360 were: 2-butanone (1 detection), acetone (4 detections), benzene (8 detections), carbon disulfide (1 detection), chlorobenzene (1 detection), ethylbenzene (13 detections), m & p-xylene (14 detections), o-xylene (12 detections), styrene (1 detection), and toluene (10 detections). A total of 43 exceedances of the RBSLs were found at Tank 360. The exceedances were for benzene (8 exceedances), ethylbenzene (13 exceedances), m & p-xylene (10 exceedances), o-xylene (7 exceedances), and toluene (5 exceedances). The maximum concentrations detected were 170,000 µg/Kg, 17,000 µg/Kg, 90,000 µg/Kg, 57,000 µg/Kg, and 75,000 µg/Kg, respectively.

Surface Soil SVOCs: Fourteen SVOCs were detected in surface soil at Tank 360. The SVOCs detected were: 2,4-dimethylphenol(5 detections), 2,4-dinitrotoluene (1 detection), 2-methylphenol (5 detections), 3&4 methylphenol (5 detections), acenaphthene (1 detection), benzo(a)anthracene (1 detection), benzo(a)pyrene (1 detection), benzo(b)fluoranthene (1 detection), bis(2-ethylhexylphthalate (1 detection),

di-n-butyl phthalate (2 detections), fluorene (1 detection), naphthalene (2 detections), phenol (7 detections), and sulfolane (10 detections). A total of 15 exceedances of the RBSLs were found at Tank 360. The exceedances were for 2,4-dinitrotoluene (1 exceedance), benzo(a)anthracene (1 exceedance), benzo(a)pyrene (1 exceedance), benzo(b)fluoranthene (1 exceedance), naphthalene (1 exceedance), and sulfolane (10 exceedances). The maximum concentrations detected were: 450 µg/Kg, 44 µg/Kg, 40 µg/Kg, 53 µg/Kg, 1,000 µg/Kg, and 3,100 µg/Kg, respectively.

Subsurface Soil SVOCs: Twelve SVOCs were detected in subsurface soil at Tank 360. The SVOCs detected were: 2,4-dimethylphenol (4 detections), 2,4-dinitrotoluene (1 detection), 2-methylphenol (4 detections), 3 & 4 methylphenol (4 detections), acenaphthene (2 detections), bis(2-ethylhexyl)phthalate (3 detections),di-n-butyl phthalate (2 detections), fluorene (4 detections), naphthalene (6 detections), phenol (5 detections), pyrene (1 detection), and sulfolane (10 detections). A total of 15 exceedances of the RBSLs were found at Tank 360. The exceedances were for 2,4-dinitrotoluene (1 exceedance), bis(2-ethylhexyl)phthalate (2 exceedances), naphthalene (2 exceedances), and sulfolane (10 exceedances). The maximum concentrations detected were: 440 µg/Kg, 1,100 µg/Kg, 1,800 µg/Kg, and 620 µg/Kg, respectively.

Surface Soil Metals: Sixteen metals were detected in surface soil at Tank 360. Ten of the detected metals were found at levels exceeding the RBSLs (Table 4-30); however, only two metals, cadmium and copper were determined to be site-related based on the statistical background comparison.

Cadmium exceeded the RBSL in 11 of the 11 detections out of 17 samples (11 exceedances/11 detects/17 samples). Similarly the exceedances/detections/total samples statistics for copper are 17/17/17.

Subsurface Soil Metals: Sixteen metals were detected in subsurface soil at Tank 360. Nine of the detected constituents were found at levels exceeding the RBSLs (Table 4-31); however, only two metals, cadmium and copper were determined to be site-related based on the statistical background comparison.

Cadmium exceeded the RBSL in 6 of the 6 detections out of 17 samples (6 exceedances/6 detects/17 samples). Similarly the exceedances/detections/total samples statistics for copper are 12/12/17.

4.2.14   Tank 401

Tank 401 was a 35-ft diameter tank that was used to store paraxylene. The Tank 401 sampling design is displayed in Figure 4-15. Sampling conducted during the implementation of the SMP found that 5 of the 5 sampling locations contained exceedances of the screening levels. These exceedances were at the northern, southern, eastern, western, and center sample locations.

A 12-ft × 12-ft grid was established and a total of 15 surface soil and 15 subsurface soil samples were collected from 9 planned locations and 6 step out locations. A total of 16 borings were drilled at Tank 401 including 14 for soil sampling, 1 for soil and groundwater sampling, and 1 for groundwater sampling.

The analytical results for the soil samples are presented in Tables 4-32 and 4-33. A summary of the detections and most significant RBSL exceedances at Tank 401 are presented below.

Surface Soil VOCs: Four VOCs were detected in the surface soil at Tank 401. The VOCs detected at Tank 401 were: acetone (2 detections), ethylbenzene (2 detections), methyl tert-butyl ether (1 detection), and m & p-xylene (12 detections). A total of 8 exceedances of the RBSLs were found at Tank 401. The exceedances were for ethylbenzene (1 exceedance) and m & p-xylene (7 exceedances). The maximum concentrations detected were: 270,000 µg/Kg and 410,000 µg/Kg, respectively.

Subsurface Soil VOCs: Eight VOCs were detected in subsurface soil at Tank 401. The VOCs detected at Tank 401 were: 2-butanone (2 detections), acetone (5 detections), carbon disulfide (1 detection), ethylbenzene (5 detections), methyl tert-butyl ether (2 detections), m & p-xylene (12 detections), o-xylene (2 detections), and toluene (1 detection). A total of 15 exceedances of the RBSLs were found at Tank 401. The exceedances were for ethylbenzene (5 exceedances), m & p-xylene (8 exceedances) and o-xylene (2 exceedances). The maximum concentrations for these constituents were: 1,400 µg/Kg, 3,700,000 µg/Kg, and 2,700 µg/Kg, respectively.

Surface Soil SVOCs: One SVOC was detected in the surface soil at Tank 401. The SVOC detected at Tank 401 was 2,4-dimethylphenol (1 detection). The detection did not exceed the RBSL.

Subsurface Soil SVOCs: Three SVOCs were detected in the subsurface soil at Tank 401. The SVOCs detected were: 2,4-dimethylphenol (5 detections), 2,4-dinitrotoluene (1 detection), and bis(2-ethylhexyl) phthalate (1 detection). A total of two exceedances of the RBSLs were found at Tank 401. The exceedances were for 2,4-dinitrotoluene (1 exceedance) and bis(2-ethylhexyl) phthalate (1 exceedance). The maximum concentrations detected were: 450 µg/Kg and 650 µg/Kg, respectively.

Surface Soil Metals: Seventeen metals were detected in surface soil at Tank 401. Twelve of the detected metals were found at levels exceeding the RBSLs (Table 4-32); however, only three metals, cadmium, copper, and nickel were determined to be site-related based on the statistical background comparison.

Cadmium exceeded the RBSL in 8 of the 8 detections out of 15 samples (8 exceedances/8 detects/15 samples). Similarly the exceedances/detections/total samples statistics for copper are 11/15/15, and those for nickel are 8/15/15.

Subsurface Soil Metals: Seventeen metals were detected in subsurface soil at Tank 401. Eleven of the detected constituents were found at levels exceeding the RBSLs (Table 4-33); however, only three metals, cadmium, copper, and nickel were determined to be site-related based on the statistical background comparison.

Cadmium exceeded the RBSL in 9 of the 9 detections out of 15 samples (9 exceedances/9 detects/15 samples). Similarly the exceedances/detections/total samples statistics for copper are 15/15/15, and those for nickel are 5/15/15.

4.2.15   Tank 403

Tank 403 was a 35-ft diameter tank that was used to store paraxylene. The Tank 403 sampling design is displayed in Figure 4-16. Sampling conducted during the implementation of the SMP found that 2 of the 5 sampling locations contained exceedances of the screening levels. The exceedances were at the southern and eastern sample locations.

A 12-ft × 12-ft grid was established and a total of 13 surface and 13subsurface soil samples were collected including 9 planned locations and 4 step out locations. A total of 14 borings were drilled at Tank 403 including 12 for soil sampling, 1 for soil and groundwater sampling, and 1 for groundwater sampling.

The analytical results for the surface soil and subsurface soil samples are presented in Tables 4-34 and 4-35. A summary of the soil detections and the most significant RBSL exceedances at Tank 403 are presented below.

Surface Soil VOCs: Three VOCs were detected in the surface soil at Tank 403. The VOCs detected at Tank 403 were: acetone (1 detection), ethylbenzene (6 detections), and m & p-xylene (9 detections). A

total of 10 exceedances of the RBSLs were found at Tank 403. The exceedances were for ethylbenzene (6 exceedances) and m & p-xylene (4 exceedances). The maximum concentrations detected were: 80,000 µg/Kg, and 110,000 µg/Kg, respectively.

Subsurface Soil VOCs: Five VOCs were detected in subsurface soil at Tank 403. The VOCs detected at Tank 403 were: 2-butanone (1 detection), acetone (5 detections), ethylbenzene (8 detections), m & p-xylene (8 detections), and o-xylene (1 detection). A total of 14 exceedances of the RBSLs were found at Tank 403. The exceedances were for ethylbenzene (8 exceedances), m & p-xylene (5 exceedances) and o-xylene (1 exceedance). The maximum concentrations detected were: 470,000 µg/Kg, 600,000 µg/Kg, and 2,800 µg/Kg, respectively.

Surface Soil SVOCs: Three SVOCs were detected in the surface soil at Tank 403. The SVOCs detected were: 2,4-dimethylphenol (1 detection) 3 & 4 methylphenol (1 detection), and bis(2-ethylhexyl) phthalate (2 detections). Only one exceedance of the RBSLs was found at Tank 403. The exceedance was for bis(2-ethylhexyl) phthalate (1 exceedance). The maximum concentration detected was 190 µg/Kg.

Subsurface Soil SVOCs: Three SVOCs were detected in subsurface soil at Tank 403. The SVOCs detected were: 2,4-dimethylphenol (5 detections), bis(2-ethylhexyl) phthalate (1 detection), and chrysene (1 detection). Only one exceedance of the RBSLs was found at Tank 403. The exceedance was for bis(2-ethylhexyl) phthalate (1 exceedance). The maximum concentration detected was 170 µg/Kg.

Surface Soil Metals: Seventeen metals were detected in surface soil at Tank 403. Twelve of the detected metals were found at levels exceeding the RBSLs (Table 4-34); however, only three metals, cadmium, copper, and nickel were determined to be site-related based on the statistical background comparison.

Cadmium exceeded the RBSL in 1 of the 1 detections out of 13 samples (1 exceedances/1 detects/13 samples). Similarly the exceedances/detections/total samples statistics for copper are 12/13/13, and those for nickel are 5/13/13.

Subsurface Soil Metals: Sixteen metals were detected in subsurface soil at Tank 403. Twelve of the detected constituents were found at levels exceeding the RBSLs (Table 4-35); however, only three metals, cadmium, copper, and nickel were determined to be site-related based on the statistical background comparison.

Cadmium exceeded the RBSL in 5 of the 5 detections out of 13 samples (5 exceedances/5 detects/13 samples). Similarly the exceedances/detections/total samples statistics for copper are 13/13/13, and those for nickel are 2/13/13.

4.2.16   Tank 540

Tank 540 was a 20-ft diameter tank that was used to store sulfolane. The Tank 540 sampling design is displayed in Figure 4-17. Sampling conducted during the implementation of the SMP found that 3 of the 5 sampling locations contained exceedances of the screening levels. These exceedances were at the northeastern, southwestern, and center sample locations.

A 11-ft × 11-ft grid was established and a total of 13 surface soil and 13 subsurface soil samples were collected including 9 planned locations and 4 step out locations. A total of 13 borings were drilled at Tank 540 including 11 for soil sampling and 2 for soil and groundwater sampling.

The analytical results for the surface soil and subsurface soil samples are presented in Tables 4-36 and 4-37. A summary of the soil detections and the most significant RBSL exceedances at Tank 540 are presented below.

Surface Soil VOCs: Eight VOCs were detected in the surface soil at Tank 540. The VOCs detected at Tank 540 were: 2-butanone (4 detections), acetone (7 detections), benzene (7 detections), carbon disulfide (6 detections), ethylbenzene (7 detections), m & p-xylene (8 detections), o-xylene (5 detections), and toluene (2 detections). A total of 19 exceedances of the RBSLs were found at Tank 540. The exceedances were for benzene (7 exceedances), ethylbenzene (6 exceedances), m & p-xylene (4 exceedances), and o-xylene (2 exceedances). The maximum concentrations detected were: 2,300 µg/Kg, 56,000 µg/Kg, 15,000 µg/Kg, and 1,500 µg/Kg, respectively.

Subsurface Soil VOCs: Nine VOCs were detected in subsurface soil at Tank 540. The VOCs detected at Tank 540 were: 2-butanone (3 detections), acetone (10 detections), benzene (2 detections), carbon disulfide (12 detections), ethylbenzene (3 detections), m & p-xylene (3 detections), o-xylene (2 detections), styrene (1 detection), and toluene (2 detections). A total of 6 exceedances of the RBSLs were found at Tank 540. The exceedances were for benzene (2 exceedances), ethylbenzene (1 exceedance), m & p-xylene (1 exceedance), o-xylene (1 exceedance), and toluene (1 exceedance). The maximum concentrations detected were: 17,000 µg/Kg, 54,000 µg/Kg, 220,000 µg/Kg , 89,000 µg/Kg, and 260,000 µg/Kg, respectively.

Surface Soil SVOCs: Sixteen SVOCs were detected in the surface soil at Tank 540. The SVOCs detected were: 2-methylphenol (1 detection), 3 & 4 methylphenol (1 detection), acenaphthene (1 detection), anthracene (1 detection), benzo(a)anthracene (1 detection), benzo(a)pyrene (1 detection), benzo(b)fluoranthene (1 detection), bis(2-ethylhexyl) phthalate (1 detection), chrysene (1 detection), di-n-butyl phthalate (1 detection), fluoranthene (1 detection), fluorene (1 detection), indeno(1,2,3-cd)pyrene (1 detection), naphthalene (2 detections), pyrene (1 detection) and sulfolane (12 detections). A total of 17 exceedances of the RBSLs were found at Tank 540. The exceedances were for benzo(a)anthracene (1 exceedance), benzo(a)pyrene (1 exceedance), benzo(b)fluoranthene (1 exceedance), bis(2-ethylhexyl) phthalate (1 exceedance), indeno(1,2,3-cd)pyrene (1 exceedance), and sulfolane (12 exceedances). The maximum concentrations detected were: 98 µg/Kg, 52 µg/Kg, 270 µg/Kg, 460 µg/Kg, 100 µg/Kg, and 17,000,000 µg/Kg, respectively.

Subsurface Soil SVOCs: Eight SVOCs were detected in subsurface soil at Tank 540. The SVOCs detected were: acenaphthene(1 detection), benzo(b)fluoranthene (1 detection), bis(2-ethylhexyl)phthalate (2 detections), chrysene (1 detection), fluorene (1 detection), naphthalene (1 detection), pyrene (1 detection), and sulfolane (12 detections). A total of 16 exceedances of the RBSLs were found at Tank 540. The exceedances were for benzo(b)fluoranthene (1 exceedance), bis(2-ethylhexyl)phthalate (2 exceedances), naphthalene (1 exceedance), and sulfolane (12 exceedances). The maximum concentrations detected were: 46 µg/Kg, 200 µg/Kg, 5,600 µg/Kg and 370,000 µg/Kg, respectively.

Surface Soil Metals: Sixteen metals were detected in surface soil at Tank 540. Thirteen of the detected metals were found at levels exceeding the RBSLs (Table 4-36); however, only three metals, cadmium, copper, and nickel were determined to be site-related based on the statistical background comparison.

Cadmium exceeded the RBSL in 10 of the 10 detections out of 13 samples (10 exceedances/10 detects/13 samples). Similarly the exceedances/detections/total samples statistics for copper are 13/13/13, and those for nickel are 3/13/13.

Subsurface Soil Metals: Sixteen metals were detected in subsurface soil at Tank 540. Nine of the detected constituents were found at levels exceeding the RBSLs (Table 4-37); however, only two metals, cadmium and copper were determined to be site-related based on the statistical background comparison.

Cadmium exceeded the RBSL in 9 of the 9 detections out of 13 samples (9 exceedances/9 detects/13 samples). Similarly the exceedances/detections/total samples statistics for copper are 13/13/13.

4.2.17   Tank 690

Tank 690 was a 20-ft diameter tank that was used to store orthoxylene. The Tank 690 sampling design is displayed in Figure 4-18. Sampling conducted during the implementation of the SMP found that 1 of the 3 sampling locations contained exceedances of the screening levels. This exceedance was at the southwestern sample location.

A 7-ft × 7-ft grid was established and a total of 13 surface soil and 13 subsurface soil samples were collected including 9 planned locations and 4 step-out locations. A total of 14 borings were drilled at Tank 690 including 12 for soil sampling, 1 for soil and groundwater sampling, and 1 for groundwater sampling.

The analytical results for the surface soil and subsurface soil samples are presented in Tables 4-38 and 4-39. A summary of the soil detections and the most significant RBSL exceedances at Tank 690 are presented below.

Surface Soil VOCs: Four VOCs were detected in the surface soil at Tank 690. The VOCs detected at Tank 690 were: acetone (4 detections), m & p-xylene (3 detections), o-xylene (5 detections), and styrene (1 detection). Two exceedances of the RBSLs were found at Tank 690. The exceedances were for o-xylene (2 exceedance). The maximum concentration detected was 36,000 µg/Kg.

Subsurface Soil VOCs: Seven VOCs were detected in subsurface soil at Tank 690. The VOCs detected at Tank 690 were: 2-butanone (3 detections), acetone (6 detections), benzene (6 detections), ethylbenzene (8 detections), m & p-xylene (9 detections), o-xylene (10 detections), and styrene (3 detections). A total of 19 exceedances of the RBSLs were found at Tank 690. The exceedances were for benzene (6 exceedances), ethylbenzene (8 exceedance), and o-xylene (5 exceedances). The maximum concentrations detected were: 840 µg/Kg, 940 µg/Kg, and 54,000 µg/Kg, respectively.

Surface Soil SVOCs: Nine SVOCs were detected in the surface soil at Tank 690. The SVOCs detected were: 2,4-dimethylphenol (3 detections), benzo(a)anthracene (1 detection), benzo(a)pyrene (1 detection), benzo(b)fluoranthene (2 detections), bis(2-ethylhexyl) phthalate (9 detections), fluoranthene (1 detection), indeno(1,2,3-cd)pyrene (1 detection), pyrene (1 detection), and sulfolane (1 detection). A total of 11 exceedances of the RBSLs were found at Tank 690. The exceedances were for benzo(a)anthracene (1 exceedance), benzo(a)pyrene (1 exceedance), benzo(b)fluoranthene (2 exceedances), bis(2-ethylhexyl) phthalate (5 exceedances), indeno(1,2,3-cd)pyrene (1 exceedance), and sulfolane (1 exceedance). The maximum concentrations detected were: 87 µg/Kg, 180 µg/Kg, 56 µg/Kg, 7,200 µg/Kg, 75 µg/Kg, and 170 µg/Kg, respectively.

Subsurface Soil SVOCs: Eight SVOCs were detected in subsurface soil at Tank 690. The SVOCs detected were: benzo(a)anthracene (1 detection), benzo(a)pyrene (1 detection), benzo(b)fluoranthene (1 detection), bis(2-ethylhexyl) phthalate (4 detections), fluoranthene (1 detection), fluorene (2 detections), indeno(1,2,3-cd)pyrene (2 detections), and pyrene (1 detection). A total of 8 exceedances of the RBSLs were found at Tank 690. The exceedances were for benzo(a)anthracene (1 exceedance), benzo(a)pyrene (1 exceedance), benzo(b)fluoranthene (1 exceedance), bis(2-ethylhexyl) phthalate (3

exceedances), and indeno(1,2,3-cd)pyrene (2 exceedances). The maximum concentrations detected were 110 µg/Kg, 83 µg/Kg, 92 µg/Kg, 4,800 µg/Kg, and 49 µg/Kg, respectively.

Surface Soil Metals: Seventeen metals were detected in surface soil at Tank 690. Twelve of the detected metals were found at levels exceeding the RBSLs (Table 4-38); however, only three metals, cadmium, copper, and nickel were determined to be site-related based on the statistical background comparison.

Cadmium exceeded the RBSL in 9 of the 9 detections out of 13 samples (9 exceedances/9 detects/13 samples). Similarly the exceedances/detections/total samples statistics for copper are 13/13/13, and those for nickel are 2/13/13.

Subsurface Soil Metals: Seventeen metals were detected in subsurface soil at Tank 690. Eleven of the detected constituents were found at levels exceeding the RBSLs (Table 4-39); however, only three metals, cadmium and copper were determined to be site-related based on the statistical background comparison.

Cadmium exceeded the RBSL in 9 of the 9 detections out of 13 samples (9 exceedances/9 detects/13 samples). Similarly the exceedances/detections/total samples statistics for copper are 13/13/13.

4.2.18   Tank 700

Tank 700 was a 20-ft diameter tank that was used to store orthoxylene. The Tank 700 sampling design is displayed in Figure 4-19. Sampling conducted during the implementation of the SMP found that 2 of the 3 sampling locations contained exceedances of the screening levels. These exceedances were at the northern and southeastern sample locations.

A 7-ft × 7-ft grid was established and a total of 13 surface soil and 13 subsurface soil samples were collected from 9 planned locations and 4 step out locations. A total of 14 borings were drilled at Tank 700 including 12 for soil sampling, 1 for soil and groundwater sampling, and 1 for groundwater sampling.

The analytical results for the surface soil and subsurface soil samples are presented in Tables 4-40 and 4-41. A summary of the soil detections and the most significant RBSL exceedances at Tank 700 are presented below.

Surface Soil VOCs: Eight VOCs were detected in the surface soil at Tank 700. The VOCs detected at Tank 700 were: 2-butanone (1 detection), acetone (6 detections), benzene (3 detections), ethylbenzene (6 detections), m & p-xylene (10 detections), o-xylene (9 detections), styrene (4 detections), and toluene (3 detections). A total of 11 exceedances of the RBSLs were found at Tank 700. The exceedances were for benzene (3 exceedances), ethylbenzene (4 exceedances), m & p-xylene (1 exceedances) and o-xylene (3 exceedances). The maximum concentrations detected were: 180 µg/Kg, 390 µg/Kg, 900 µg/Kg, and 42,000 µg/Kg, respectively.

Subsurface Soil VOCs: Seven VOCs were detected in subsurface soil at Tank 700. The VOCs detected at Tank 700 were: acetone (4 detections), benzene (8 detections), ethylbenzene (11 detections), m & p-xylene (13 detections), o-xylene (13 detections), styrene (5 detections), and toluene (1 detection). A total of 31 exceedances of the RBSLs were found at Tank 700. The exceedances were for benzene (8 exceedances), ethylbenzene (9 exceedances), m & p-xylene (6 exceedance), o-xylene (6 exceedances), and styrene (1 exceedance). The maximum concentrations detected were: 780 µg/Kg, 5,300 µg/Kg, 52,000 µg/Kg, 270,000 µg/Kg, and 15,000 µg/Kg, respectively.

Surface Soil SVOCs: Four SVOCs were detected in the surface soil at Tank 700. The SVOCs detected were: 2,4-dimethylphenol (1 detection), benzo(b)fluoranthene (1 detection), bis(2-ethylhexyl) phthalate (6 detections), and sulfolane (2 detections). A total of 7 exceedances of the RBSLs were found at Tank 700. The exceedances were for benzo(b)fluoranthene (1 exceedance), bis(2-ethylhexyl) phthalate (4

exceedances) and sulfolane (2 exceedances). The maximum concentrations detected were: 45 µg/Kg, 2,700 µg/Kg, and 510 µg/Kg, respectively.

Subsurface Soil SVOCs: Eleven SVOCs were detected in subsurface soil at Tank 700. The SVOCs detected were: 2,4-dimethylphenol (5 detections), anthracene (2 detections), benzo(b)fluoranthene (2 detections), bis(2-ethylhexyl) phthalate (5 detections), chrysene (2 detections), fluoranthene (1 detection), fluorene (3 detections), naphthalene (3 detections), phenol (4 detections), pyrene (2 detections), and sulfolane (5 detections). A total of 11 exceedances of the RBSLs were found at Tank 700. The exceedances were for benzo(b)fluoranthene (2 exceedances), bis(2-ethylhexyl) phthalate (4 exceedances),and sulfolane (5 exceedances). The maximum concentrations detected were: 200 µg/Kg, 170 µg/Kg, and 230 µg/Kg, respectively.

Surface Soil Metals: Eighteen metals were detected in surface soil at Tank 700. Thirteen of the detected metals were found at levels exceeding the RBSLs (Table 4-40); however, only three metals, cadmium, copper, and nickel were determined to be site-related based on the statistical background comparison.

Cadmium exceeded the RBSL in 10 of the 10 detections out of 13 samples (10 exceedances/10 detects/13 samples). Similarly the exceedances/detections/total samples statistics for copper are 13/13/13, and those for nickel are 4/13/13.

Subsurface Soil Metals: Eighteen metals were detected in subsurface soil at Tank 700. Eleven of the detected constituents were found at levels exceeding the RBSLs (Table 4-41); however, only two metals, cadmium and copper were determined to be site-related based on the statistical background comparison.

Cadmium exceeded the RBSL in 9 of the 9 detections out of 13 samples (9 exceedances/9 detects/13 samples). Similarly the exceedances/detections/total samples statistics for copper are 13/13/13.

4.2.19   Tank 710

Tank 710 was a 150-ft diameter tank that was used to store paraxylene. The Tank 710 sampling design is displayed in Figure 4-20. Sampling conducted during the implementation of the SMP found that 1 of the 5 sampling locations contained exceedances of the screening levels. This exceedance was at the eastern sample location.

A 50-ft × 50-ft grid was established generating 9 sample locations. Surface soil and subsurface soil samples were collected at each of the 9 locations. A total of 10 borings were drilled at Tank 710 including 8 for soil sampling, 1 for soil and groundwater sampling, and 1 for groundwater sampling.

The analytical results for the surface soil and subsurface soil samples are presented in Tables 4-42 and 4-43. A summary of the soil detections and the most significant RBSL exceedances at Tank 710 are presented below.

Surface Soil VOCs: Seven VOCs were detected in the surface soil sample at Tank 710. The VOCs detected at Tank 710 were: 2-butanone (2 detections), acetone (5 detections), carbon disulfide (1 detection), methyl tert-butyl ether (1 detection), m & p-xylene (2 detections), o-xylene (1 detection), and toluene (1 detection). None of the detections exceeded the corresponding RBSLs..

Subsurface Soil VOCs: Five VOCs were detected in the subsurface soil at Tank 710. The VOCs detected at Tank 710 were: 2-butanone (1 detection), acetone (6 detections) carbon disulfide (2 detections), ethylbenzene (3 detections), and m & P-xylene (5 detections). One detection of ethylbenzene at a concentration of 140 µg/Kg exceeded the RBSL.

Surface Soil SVOCs: Six SVOCs were detected in the surface soil sample at Tank 710. The SVOCs detected at Tank 710 were: benzo(a)pyrene (3 detections), benzo(b)fluoranthene (3 detections), bis(2-ethylhexyl) phthalate (1 detection), chrysene (1 detection), di-n-butyl phthalate (2 detections), and indeno(1,2,3-cd)pyrene (3 detections). A total of 9 exceedances of the RBSLs were found at Tank 710. The exceedances were for benzo(a)pyrene (3 exceedances), benzo(b)fluoranthene (3 exceedances), bis(2-ethylhexyl) phthalate (1 exceedance), and indeno(1,2,3-cd)pyrene (2 exceedances). The maximum concentrations detected were: 180 µg/Kg, 180 µg/Kg, 380 µg/Kg, and 81 µg/Kg, respectively.

Subsurface Soil SVOCs: One SVOC was detected in the surface soil sample at Tank 710. The SVOC detected at Tank 710 was: bis(2-ethylhexyl) phthalate (2 detections). The detections did not exceed the RBSL.

Surface Soil Metals: Seventeen metals were detected in surface soil at Tank 710. Thirteen of the detected metals were found at levels exceeding the RBSLs (Table 4-42); however, only three metals, cadmium, copper, and nickel were determined to be site-related based on the statistical background comparison.

Cadmium exceeded the RBSL in 9 of the 9 detections out of 9 samples (9 exceedances/9 detects/9 samples). Similarly the exceedances/detections/total samples statistics for copper are 9/9/9, and those for nickel are 4/9/9.

Subsurface Soil Metals: Seventeen metals were detected in the subsurface soil at Tank 710. Eleven of the detected constituents were found at levels exceeding the RBSLs (Table 4-43); however, only three metals, cadmium, copper, and nickel were determined to be site-related based on the statistical background comparison.

Cadmium exceeded the RBSL in 9 of the 9 detections out of 9 samples (9 exceedances/9 detects/9 samples). Similarly the exceedances/detections/total samples statistics for copper are 6/9/9, and those for nickel are 1/9/9.

4.3   Groundwater Sampling Results

Groundwater samples were collected at each of the 19 AOCs. As previously discussed, one sample was collected from an upgradient location and one sample was collected from a downgradient location. Additionally, groundwater samples were collected from 78 existing monitoring wells including 54 wells that are routinely sampled during the semi-annual sampling event plus 24 additional monitoring wells. The samples collected from the monitoring wells were analyzed for the same constituents as the AOC groundwater samples. The monitoring wells were sampled to provide a site wide view of the nature and extent of groundwater contamination.

4.3.1   AOC Groundwater Data

A total of 38 groundwater samples were collected as part of the AOC investigation. Figures 4-2 through 4-20 present the locations of the groundwater samples for each AOC. It should be noted that the AOC groundwater samples were collected as grab samples from an open borehole in accordance with the approved work plan. No screen was placed, there was no development prior to sampling and, only one reading of field parameters (i.e., pH conductivity, temperature, dissolved oxygen and, oxidation reduction potential) was recorded. It is noted that, the samples often contained fine sediments that may influence the analytical results, the metals results in particular. Because of this, the groundwater samples that were collected from the open boreholes during the AOC investigation are discussed separately from the groundwater data collected from existing monitoring wells. The field records for the borehole sampling are included in Appendix A.

Table 4-44 presents summary statistics for the AOC groundwater data. As shown, Table 4-44 presents a summary of analytes detected, the number of samples, number of detections, the maximum detection and number detections that exceeded the RBSLs for AOC groundwater. Tables 4-45 through 4-63 present all of the analytical results for groundwater at the 19 AOCs.

The samples collected from the open borehole were analyzed for the Modified Skinner List of constituents (Table 1-1). A summary of the detections and exceedances of the groundwater RBSLs are presented below.

VOCs: Ten VOCs were detected in AOC groundwater. The VOCs detected were: acetone (5 detections), benzene (26 detections), carbon disulfide (1 detection), chlorobenzene (1 detection), ethylbenzene (29 detections), methyl tert-butyl ether (2 detections), m & p-xylene (33 detections), o-xylene (26 detections), styrene (7 detections) and toluene (20 detections). Of these chemicals only six were detected at levels above their RBSLs including benzene (26 exceedances), ethylbenzene (29 exceedances), methyl tert-butyl ether (1 exceedance), m & p-xylene (21 exceedances), o-xylene (14 exceedances) and toluene (6 exceedances).

SVOCs: Twelve SVOCs were detected in AOC groundwater. The SVOCs detected were: 2,4-dimethylphenol (4 detections), 2,4-dinitrotoluene (2 detections), 3 & 4 methylphenol (10 detections), acenaphthene (6 detections), anthracene (3 detections), benzo(a)pyrene (1 detection), fluoranthene (3 detections), fluorene (14 detections), naphthalene (25 detections), phenol (9 detections), pyrene (3 detections), and sulfolane (35 detections). Of these chemicals only four were detected at levels above their RBSLs including 2,4-dinitrotoluene (2 exceedances), benzo(a)pyrene (1 exceedance), naphthalene (3 exceedances) and sulfolane (26 exceedances).

Metals: Eighteen metals were detected in the AOC groundwater. Sixteen of the detected constituents were found at levels exceeding the RBSLs. Antimony, mercury, selenium and zinc were only detected above their RBSL once in the 38 samples. Arsenic, barium, beryllium, cadmium, cobalt, copper, lead, manganese and vanadium were the metals constituents that were most frequently detected above their respective RBSLs.

4.3.2   Expanded Semi-Annual Groundwater Monitoring Data

Two rounds of groundwater sampling data were collected; in May/June 2012 and in December 2012. The May/June 2012 sampling event was a comprehensive sampling event that included the regularly monitored corrective action (CA) and VISM wells, and additional wells that are not part of regular monitoring. A total of 78 wells were sampled in May/June 2012. The December 2012 sampling event included the 54 regularly monitored CA and VISM wells. The combined May/June 2012 and December 2012 dataset were used to describe the nature and extent of contamination and for risk characterization.

A total of 79 existing groundwater monitoring wells were targeted for sampling in the May/June 2012 sampling event. One well, MW-112, was dry during the sampling event and was not able to be sampled. Therefore, 78 groundwater samples were collected in May/June 2012. All planned wells were sampled during the December 2012 event. The wells were sampled using low flow sampling techniques using a peristaltic pump and dedicated tubing.

The analyses for the May/June 2012 included the complete list of the modified Skinner chemicals (Table 1-1). The December 2012 samples were analyzed for the regularly monitored site contaminants, BTEX, MTBE or naphthalene. However, sulfolane analysis was added for the 45 CA well samples.

Figures 4-25 through 4-28 present the locations of the upper alluvial aquifer monitoring wells that were sampled in May/June 2012 and December 2012. Figures 4-29 and 4-32 present the locations of the lower alluvial aquifer monitoring wells that were sampled in May/June 2012 and December 2012. The results of the expanded groundwater sampling are summarized in Table 4-64 through 4-67.

The samples collected from the monitoring wells were analyzed for the Modified Skinner List of constituents. A summary of the detections and exceedances of the groundwater RBSLs for the combined May/June 2012 and December 2012 dataset is presented below.

VOCs: Ten VOCs were detected in upper alluvial aquifer groundwater and seven VOCs were detected in lower alluvial aquifer groundwater. The VOCs detected in the upper alluvial aquifer were: 1,2 dichlorobenzene (2 detections), 1,4 dichlorobenzene (3 detections), acetone (1 detection), benzene (31 detections), chlorobenzene (8 detections), ethylbenzene (27 detections), methyl tert-butyl ether (28 detections), m & p-xylene (28 detections), o-xylene (18 detections) and toluene (13 detections). In lower alluvial aquifer groundwater the detections were: benzene (11 detections), chlorobenzene (1 detection), chloroform (1 detection), ethylbenzene (1 detection), methyl tert-butyl ether (11 detections), m & p-xylene (1 detection), and tetrachloroethene (2 detections).

Of these chemicals, only 7 exceeded their RBSLs in the upper alluvial aquifer including 1,4 dichlorobenzene (3 exceedances), benzene (30 exceedances), ethylbenzene (20 exceedances), methyl tert-butyl ether (2 exceedance), m & p-xylene (11 exceedance), o-xylene (7 exceedances) and toluene (4 exceedances). In the lower alluvial aquifer, the exceedances included benzene (11 exceedances), chloroform (1 exceedance) and methyl tert-butyl ether (1 exceedance).

SVOCs: Eighteen SVOCs were detected in upper alluvial aquifer groundwater and five SVOCs were detected in lower alluvial aquifer groundwater. The SVOCs detected in the upper alluvial aquifer were: 2,4-dimethylphenol (4 detections), 2-methylphenol (2 detection), 3&4 methylphenol (7 detections), acenaphthene (15 detections), anthracene (9 detections), benzo(a)anthracene (1 detection), benzo(a)pyrene (1 detection), benzo(b)fluoranthene (1 detection), bis(2-ethylhexylphthalate (1 detection), chrysene (1 detection), fluoranthene (2 detections) fluorene (26 detections), indeno(1,2,3-cd)pyrene (1 detection), naphthalene (33 detections), nitrobenzene (1 detection), phenol (6 detections), pyrene (2 detections), and sulfolane (64 detections). The SVOCs detected in the lower aquifer were: acenaphthene (1 detection), bis(2-ethylhexylphthalate(2 detections), fluorene (1 detection), naphthalene (4 detections), and sulfolane (26 detections).

Of these chemicals, seven exceeded their RBSLs in the upper alluvial aquifer including benzo(a)anthracene (1 exceedance), benzo(a)pyrene (1 exceedance), benzo(b)fluoranthene (1 exceedance), bis(2-ethylhexylphthalate (1 exceedance), indeno(1,2,3-cd)pyrene (1exceedance) naphthalene (2 exceedance) and sulfolane (39 exceedances). In the lower alluvial aquifer, sulfolane exceeded the RBSL 23 times and bis(2-ethylhexyl) phthalate exceeded the RBSL twice.

Metals: Fifteen metals and cyanide were detected in upper alluvial aquifer groundwater and fourteen metals were detected in lower alluvial aquifer groundwater. In upper alluvial aquifer groundwater, 10 metals were detected above their RBSL including arsenic (27 exceedances), barium (11 exceedances), cadmium (2 exceedances), chromium (1 exceedance), hexavalent chromium (17 exceedances), cobalt (5 exceedances), lead (1 exceedance), manganese (16 exceedances), nickel (1 exceedance), and vanadium (1 exceedance). In lower alluvial aquifer groundwater, five metals were detected above their RBSLs including arsenic (8 exceedances), cadmium (1 exceedance), cobalt (2 exceedances), manganese (4 exceedances), and mercury (1 exceedance).

4.4 Effluent Channel Surface Water Results

The Effluent Channel surface water was sampled in May/June 2012 and again in December 2012. Three surface water samples were collected each time. The modified Skinner list analyses were performed for the May/June 2012 samples. The December 2012 samples were analyzed for the routine analyte suite, BTEX, MTBE and naphthalene. Additionally, sulfolane analysis was added for the December 2012 surface water samples.

The locations of the Effluent Channel surface water sample locations are presented in Figure 4-33.

Table 4-68 presents summary statistics for the May/June 2012 and December 2012 surface water samples. The analytical results for the surface water samples are presented in Table 4-69. A summary of the detections are presented below.

VOCs: No VOCs were detected in surface water.

SVOCs: Sulfolane was detected in one sample (Ditch-1) at a low estimated concentration of 0.94 µg/L during the December 2012 sampling event. Sulfolane was not detected at this location during the May/June 2012 sampling event. The detection did not exceed the RBSL.

Metals: Six metals were detected in surface water. The metals detected were: barium (3 detections), chromium (1 detection), manganese (3 detections), nickel (3 detections), vanadium (3 detections) and zinc (1 detection). None of the detections were above the RBSLs.

4.5 Effluent Channel Sediment Results

The Effluent Channel sediments were sampled in May/June 2012 and again in December 2012. Three sediment samples were collected each time. The modified Skinner list analyses were performed for the May/June 2012 samples. The December 2012 samples were analyzed for the routine analytical suite (BTEX, MTBE and naphthalene). Additionally, sulfolane analysis was added for the December 2012 sediment samples.

The locations of the Effluent Channel sediment samples are presented in Figure 4-33.

Table 4-70 presents summary statistics for sediment. The analytical results for the sediment samples are presented in Table 4-71. A summary of the detections and exceedances are presented below.

VOCs: No VOCs were detected in sediment.

SVOCs: One SVOC was detected in the sediment. Location Channel-2 had one detection of sulfolane (130 J µg/Kg) in May/June 2012. No SVOCs were detected in December 2012. The detection did not exceed the RBSL.

Metals: Fourteen metals were detected in Effluent Channel sediment. The metals detected were: arsenic, barium, beryllium, cadmium, chromium, hexavalent chromium, cobalt, copper, lead, manganese, mercury, nickel, vanadium and zinc. All fourteen metals were detected 3 times (i.e., in all 3 of the samples). None of the detections were above the RBSLs.

4.6 Chemicals of Potential Concern

The results of the RBSL screening are summarized in Table 4-72. A shown in Table 4-72, 39 chemicals were detected at levels above their respective RBSL in at least one sampled media. For the purpose of risk

assessment, a chemical detected even once above the RBSL in any of the sampled media was carried forward as a chemical of potential concern (COPC) for quantitative assessment of potential risk (Section 6).

Table 4-72 includes the chemicals detected above the RBSL in the AOC groundwater samples. It is noted that the AOC groundwater samples were collected from the open boreholes, and therefore, they are only useful for qualitative purposes and not risk assessment. With the exception of beryllium, the COPCs detected in the AOC groundwater were also common to other sampled media. Beryllium was not detected in any of the groundwater samples collected from the monitoring wells, and it did not exceed the RBSL in the 518 soil samples. Therefore, it is not a site COPC. The remaining 38 chemicals are carried forward to the quantitative risk characterization in Section 6. The presence of beryllium in the AOC groundwater is likely the result of the high turbidity caused by suspended soil in the open borehole groundwater samples.

An evaluation of the detections across all sampled media was performed and included examination of detection frequency, concentration ranges, and ratios of average concentrations to RBSLs. The evaluation indicates that benzene is responsible for the majority of potential excess risk, with ethylbenzene, m- & p-xylene and, sulfolane being the other significant risk contributors. The extent of contamination discussion below focuses on benzene and sulfolane. Consistent with previous reports, benzene was selected to represent BTEX contamination at the site. This is because benzene is the most mobile of the BTEX constituents and is found to be the primary risk driver. Sulfolane is discussed because it was frequently detected and its behavior in the environment differs from the BTEX constituents.

4.7   Extent of Contamination

The extent of benzene contamination in surface soil and subsurface soil is presented in Figure 4-21 and Figure 4-22, respectively. Benzene extent in the upper alluvial aquifer groundwater is presented in Figure 4-25 and includes the groundwater samples collected from the open boreholes during the AOC Investigation and the monitoring wells sampled during the May/June 2012 comprehensive sampling event. Figure 4-26 includes only the groundwater samples collected during the December 2012 sampling event. The analytical data for both sampling events are presented in Table 4-66.

As shown in Figure 4-21 and Figure 4-22 for surface soil and subsurface soil, respectively, benzene is above its very conservative RBSL of 0.66 µg/Kg at most sample locations with the highest levels within the footprint of the former ASTs. Outside the footprint of the former ASTs, contamination levels declined or were not detectable. This is consistent with the conceptual model of release of contaminants through holes in the bottom of the AST. Once released, the benzene contamination migrated vertically to the upper alluvial aquifer and dispersed through the sand channels into four distinct plumes (Figures 4-25 and 4-26).

As shown on Figure 4-25, one benzene plume is observed to extend from beneath the former Process Area south for about 2,800 ft terminating near former AOC Tank 360. The second plume is observed along the western edge of the Facility and its alignment is consistent with the alignment of a sand channel mapped in this area. This plume is approximately 1,300 ft in length and extends about 200 ft offsite.

The December 2012 benzene data in the upper alluvial aquifer (Figure 4-26) shows a similar distribution of benzene to the May/June 2012 data. It is noted that the December 2012 sampling included fewer wells than the May/June 2012 sampling. The December 2012 data show a decrease in benzene concentrations along the western boundary plume. At wells MW-1R and MW-28, benzene levels decreased from 1.1 µg/L to 0.62 J µg/L and from 1,300 µg/L to 580 µg/L, respectively. At well MW-13R, benzene decreased from 13 µg/L to a non-detectable level. Similarly, along the eastern side of the facility benzene levels at RW-A decreased from 32,000 µg/L to 19,000 µg/L, while TW-1R, TW-2 and, PZ-3R had slight decreases

in concentrations. Wells MW-17R and TW-4 show slight increase in the benzene concentrations, but the levels remained below the MCL.

Of particular note with respect to benzene contamination is the observation that the plume previously identified in the past reports in the southeast corner of the Facility is no longer present. Benzene was not detected in monitoring wells in the southeast corner during the May/June 2012 or the December 2012 semi-annual monitoring events.

Figure 4-29 presents the benzene data in the lower alluvial aquifer (Table 4-67) based on the May/June 2012 expanded semi-annual monitoring event, and Figure 4-30 presents the benzene data for the December 2012 sampling event. As shown in Figures 4-29 and 4-30, benzene is below detectable levels in the majority of the lower alluvial aquifer monitoring wells. Where benzene is detected, it is found in isolated areas at levels generally below the MCL of 5 µg/L. Two wells did have benzene concentrations above the MCL. These two wells, MW-30D and MW-159D, had benzene concentrations of 15 and 21 µg/L, respectively, in May/June 2012. In December 2012, benzene in MW-159D was below the MCL and it was not detected in MW-30D.

The extent of sulfolane contamination in surface soil and subsurface soil are presented in Figure 4-23 and Figure 4-24, respectively. As shown in Figure 4-23 and 4-24, sulfolane levels at most sampling locations were at levels below the conservative RBSL of 3.15 µg/Kg. Sulfolane did exceed the RBSL of 3.15 µg/Kg at twelve of the nineteen AOCs. However, the majority of the exceedances were at 4 AOCs; Tank 170, Tank 360, Tank 540, and Tank 700.

Figure 4-27 presents the extent of sulfolane in the upper alluvial aquifer and includes the groundwater samples collected from the open boreholes during the AOC Investigation and the monitoring wells sampled during the May/June 2012 comprehensive sampling event. Similar to benzene, sulfolane contamination is present in distinct plumes coincident with the presence of sand channels in the upper alluvial aquifer. As shown in Figure 4-27, one sulfolane plume is observed beneath the former Process Area. This plume extends south and east for about 2,800 ft and extends about 600 ft beyond the eastern Facility boundary and south and west about 4,200 ft and extends offsite to the west about 1,200 ft. The second plume is observed near the northwestern Facility boundary and is approximately 2,000 ft in length and extends about 600 ft offsite to the west. The third plume is found in the southeast corner of the Facility, is approximately 2,600 ft in length and extends offsite south about 1,200 ft to monitoring well MW-166.

The December 2012 sulfolane data in the upper alluvial aquifer (Figure 4-28) shows a similar distribution of sulfolane to the May/June 2012 data. It is noted that the December 2012 sampling included fewer wells than the May/June 2012 sampling. Overall, it is observed that the sulfolane in the upper aquifer in May/June 2012 and December 2012 are similar in concentration and distribution, although some slight increases and decreases occurred.

Figure 4-31 and Figure 4-32 present the sulfolane data in the lower alluvial aquifer based on the May/June 2012 and December 2012 expanded semi-annual monitoring events, respectively. As shown in Figure 4-31 for the May/June 2012 samples, sulfolane is above the RBSL of 16 µg/L in seven of the 11 onsite lower alluvial aquifer monitoring wells and in six of the twelve offsite lower alluvial aquifer monitoring wells. For the December 2012 samples (Figure 4-32), sulfolane is above the RBSL in three of the four onsite lower alluvial aquifer monitoring wells and seven of the twelve offsite lower alluvial aquifer monitoring wells. As shown in Figures 4-31 and 4-32, the sulfolane contamination extends offsite to the south and southeast of the facility. The highest concentrations are found along the western boundary (MW-159D) and south of the facility (MW-46D). The sulfolane in the lower aquifer in

May/June 2012 and December 2012 are similar in concentration and distribution, although some slight increases and decreases were noted.

In the Effluent Channel surface water, sulfolane was detected in one sample (Ditch-1) at a low estimated concentration of 0.94 µg/L during the December 2012 sampling event. Sulfolane was not detected at this location during the May/June 2012 sampling event. The detection did not exceed the RBSL

In Effluent Channel sediment, sulfolane was detected at on location (Channel-2) at a level of 130 J µg/Kg in May/June 2012. No SVOCs were detected in December 2012. The detection did not exceed the RBSL.

5.   FATE AND TRANSPORT

The following section presents an analysis of the fate and transport of benzene and sulfolane in soil and groundwater. As mentioned previously, benzene is the most mobile of the BTEX constituents and is found to be the primary risk driver (Section 6). Sulfolane, a non-target list compound, is discussed because it was frequently detected and its behavior in the environment differs from benzene. The physical properties of these chemicals are discussed followed by an analysis of their expected fate and transport in the natural environment.

5.1   Physical Considerations

The following sections provided a description of the physical characteristics of the surface soil, subsurface soil and groundwater at the Facility.

5.1.1   Soil

As mentioned previously, it was observed that the former ASTs were constructed on elevated soil platforms some as high as approximately 8 ft. The composition of the soil platforms was observed to be primarily silts and clays with minor sand content.

Below the natural grade of the site, the soil profile of the vadose zone (the unsaturated zone above the water table) was observed to be relatively thin with depth to water ranging from about 2.5 to 18 ft bgs. The lithology of the vadose zone soils based on investigation data was observed to be primarily fine grained silts and clays with some sands (Phillips, 1999).

Based on the lithology, most water during light rainfall events is expected to runoff as surface flow. The rain water that does infiltrate into the vadose zone is expected to migrate vertically. When in contact with contaminants present in the soil, this water can mobilize contaminants through the soil profile to the underlying groundwater.

5.1.2   Groundwater

The hydrogeology was described in Section 3.5 and contamination has been found in both the upper and lower alluvial aquifers with the primary impacts found in the upper alluvial aquifer.

5.2   Natural Attenuation

Natural attenuation is the processes by which contaminants in soil and groundwater are decreased or degraded through natural processes. The processes involved in natural attenuation include: adsorption, biodegradation, volatilization, dispersion and diffusion. The following subsections provide a brief summary of the processes as they relate to benzene and sulfolane.

If discharged to the environment, benzene and sulfolane have different fate and transport characteristics according to varying chemical-specific properties including:

- Water solubility,

- Organic carbon partition coefficient (Koc),

- Octanol-water partition coefficient (Kow),

- Vapor pressure,

- Henry's Law constant, and

- Biodegradation rate.

The water solubility of a chemical partly determines the extent to which a substance can partition between soil and groundwater. Both K_{oc} and K_{ow} are be used to predict the degree of chemical sorption to organics in soil. The higher the K_{ow}, the greater the affinity for partitioning to organic carbon in the soil and aquifer. Vapor pressure and the Henry's Law constant indicate how readily a compound will volatilize from water into the atmosphere. Properties of benzene and sulfolane are presented and discussed in the following sections.

5.2.1 Benzene

Benzene is a colorless liquid that has a sweet odor and is highly flammable. Benzene is volatile and readily dissolves in water. The physical and chemical properties of benzene are summarized below.

> Chemical formula – C^6H^6
> Molecular weight – 78.11 grams per mol (g/mol)
> Color – Clear, colorless liquid
> Boiling point – 80.1 °C
> Density at 15 °C, g/cm^3 – 0.8787
> Log K_{OW} – -2.13
> Log K_{OC} – 1.92
> Vapor pressure at 20 °C – 75 mm Hg
> Henry's law constant at 25 °C – 5.5x10-3 atm-m^3 /mol

Benzene is very volatile, readily partitions into the atmosphere and is only slightly soluble in water. As a result, the majority of benzene that is released to soil or water will volatilize. The most significant pathway for the degradation of atmospheric benzene is reaction with photochemically produced hydroxyl radicals. Reaction of benzene with ozone can also occur, but to a much lesser extent.

In soil, benzene can volatilize to the air, partition to surface water through runoff and partition to groundwater through leaching. Organic matter facilitates the adsorption of benzene to soil. Benzene can biodegrade in soil under both aerobic and anaerobic conditions.

In water, the primary mechanism of benzene degradation is aerobic biodegradation; however anaerobic degradation can occur when other electron acceptors such as nitrate and sulfate are present and through methanogenesis. Methanogenesis, which carbon dioxide is the terminal electron acceptor, is typically a self-perpetuating reaction because there is almost an inexhaustible supply of carbon dioxide in most aquifer systems and because there is a net production of carbon dioxide during this reaction.

5.2.2 Sulfolane

Sulfolane in pure form is a clear, colorless liquid, but in industry it often takes on a light yellow color due to interaction with air. The physical and chemical properties of sulfolane are summarized below.

> Chemical formula – $C^4H^8O^2S$
> Molecular weight – 120.17 g/mol
> Color – Clear, colorless liquid; light yellow

Boiling point – 285 °C
Density at 15 °C, g/cm^3 – 1.276
Log K_{OW} – - 0.77
Log K_{OC} – 0.07
Vapor pressure at 20 °C – 0.01 mm Hg
Henry's law constant at 25 °C – 8.9×10^{-10} atm-m^3 /mol

Sulfolane is soluble in water due to the highly polar sulfur–oxygen double bonds. Sulfolane does not volatilize from water or soil as evidenced by its low vapor pressure and Henry's Law Constant.

In soil, sulfolane does not adsorb, as shown by the log octanol/water partition coefficient (log Kow). The organic carbon partition coefficient (Koc), estimated at 0.07, shows that the compound is mobile in soil.

In water, the primary attenuation mechanism appears to be biodegradation in an aerobic environment. However, some evidence of biodegradation under specific anoxic conditions has been documented.

5.2.3   Adsorption

Unlike a water particle or conservative solute, an organic solute particle may partition (or adsorb) from the groundwater to the aquifer matrix. As a result of this adsorption process, the movement of the solute particle is slowed down (retarded) relative to the movement of groundwater. The degree to which contaminants are adsorbed on soils is dependent on the fraction of organic carbon (f_{oc}) and the chemical-specific water/carbon-partitioning coefficient (K_{oc}). Adsorption of benzene and sulfolane are examined below.

To estimate the amount of soil partitioning, and hence retardation, the ratio of hydrocarbons in the soil and water phase (the soil-water distribution coefficient - K_d) are calculated using the following equation:

$$K_d = f_{oc} \, K_{oc}$$

From information provided in the literature (Wiedemeier, et. al, 1998) values for these parameters are:

f_{oc} of 0.1% (f_{oc} = 0.001 for a medium fluvial/deltaic sand).

K_{oc} = 83 Liters/kilogram (benzene)

K_{oc} = 1.17 Liters/kilogram (sulfolane).

The value for f_{oc} of 0.1% is equivalent to 1 gram of organic carbon per 1,000 grams of sample, or 1,000 mg/Kg.

As a result of adsorption, contaminant transport velocity in the aquifer is less than the seepage velocity of the groundwater. The ratio of the velocities is expressed as:

$$V_s/V_c = R$$

Where:

V_s = average groundwater seepage velocity

V_c = average velocity of contaminants

R = coefficient of retardation.

The coefficient of retardation can be defined by the following linear relationship:

$$R = 1 + (K_d\, \theta_b/n)$$

Where:

R= coefficient of retardation

K_d = distribution coefficient for benzene (0.083 Liters/kilogram)

K_d = distribution coefficient for sulfolane (0.00117 Liters/kilogram)

n = effective porosity (20% upper alluvial and 30% lower alluvial)

θ_b = soil bulk density (value of 1.7 Kg/L from Wiedemeier, et. al, September 1998).

Using these values, the following coefficients of retardation for benzene and sulfolane were calculated:

Benzene upper alluvial aquifer – 1.7

Benzene lower alluvial aquifer – 1.5

Sulfolane upper alluvial aquifer – 1.0

Sulfolane lower alluvial aquifer – 1.0.

Based on the calculations above, benzene is expected to move at a slower rate than a water particle. Sulfolane, on the other hand, is expected to travel at the same rate as a water particle and would not expect to be adsorbed onto the aquifer matrix.

5.2.4   Biodegradation

5.2.4.1   Benzene

Biodegradation of benzene under aerobic conditions is the result of metabolic activity whereby microorganisms process the petroleum hydrocarbons as food through a series of diverse reactions. The result of this metabolism is the consumption of oxygen, the destruction of benzene and other petroleum hydrocarbon and observable shifts in groundwater chemistry. At the CPCPRC site, biodegradation capacity of the aquifers was quantified based on these utilization factors and site geochemical data collected during the semi-annual monitoring events (CPCPRC, 2004). Based on that analysis, oxygen consumption and methanogenisis were found to play the dominant role in benzene degradation.

Page 209 of Wiedemeier, et. al, 1999, states that …In contrast to aerobic respiration, denitrification and sulfate reduction, all of which are purely respirative reactions that are limited by the amount of electron acceptors, methanogenesis, which carbon dioxide is the terminal electron acceptor, is typically a self-perpetuating reaction because there is almost an inexhaustible supply of carbon dioxide in most aquifer systems and because there is a net production of carbon dioxide during this reaction. This consideration serves to further highlight the importance of the methanogenesis reaction in the biodegradation of benzene at the Facility.

5.2.4.2   Sulfolane

As mentioned previously, sulfolane is a non-target list compound and only recently has been considered in the analysis of groundwater quality impacts. As such, research on sulfolane biodegradation is advancing and the processes for degradation are not yet well understood. The majority of the published

information regarding the environmental fate of sulfolane suggests that oxidation by aerobic microorganisms is the primary degradation pathway for sulfolane. This view appears to be related to the fact that aerobic sulfolane degradation has been observed by all researchers who studied it, while anaerobic sulfolane degradation has been sporadically observed.

Biodegradation of sulfolane Saint-Fort (2006) observed aerobic sulfolane degradation in aquifer microcosms, but no anaerobic degradation.

Kim et al. (1999) observed anaerobic sulfolane degradation in aquifer microcosms, but did not speculate regarding the mechanism.

Greene et al. (1998) observed anaerobic sulfolane degradation associated with nitrate reduction and manganese reduction in some of their replicates. Notably, manganese oxide was added to some of these replicates to stimulate manganese reduction. Additionally, anaerobic sulfolane degradation was observed in the replicates incubated at 8 degrees C, but not in replicates incubated at 28 degrees C. A significant lag period was observed prior to the onset of manganese reduction and sulfolane degradation. Finally, Greene et al. noted that the amount of reduced manganese observed in the microcosms was insufficient to account for complete mineralization of the sulfolane that disappeared from the microcosms.

The rate of observed sulfolane degradation was reported to have zero-order kinetics in both aerobic and anaerobic sediment microcosms (Greene et al., 1998; Greene and Fedorak, 2001, Saint-Fort, 2006). Additionally, amendment of sediment microcosms with phosphorus, while stimulating the growth of purported sulfolane-degrading organisms, was actually associated with longer lag times and, ultimately, slower sulfolane degradation rates relative to the unamended control (Greene and Fedorak, 2001).

Anaerobic sulfolane degradation resulting in the production of thiolane has been described by some researchers (Kim, 1999), but the general consensus of the literature is that the rates of anaerobic biodegradation of sulfolane are negligible compared to aerobic processes.

Finally, while much of the existing literature regarding environmental fate of sulfolane documents the lack of appearance of stiochiometric amounts of the hypothesized aerobic daughter products (carbon dioxide, sulfuric acid, hydroxybutene sulfonic acid), no other sulfolane degradation metabolites have been documented either.

5.2.5   Volatilization to the Atmosphere

Migration of volatile constituents is dependent on the depth of the contamination and the characteristics of the specific chemical. The partitioning of a compound between the water and air matrices depends on the vapor pressure and the water solubility of that compound. Compounds which have a high vapor pressure and a low water solubility readily evaporate from the liquid phase and enter the atmosphere or soil vapor. Henry's Law constant is the ratio of vapor pressure to water solubility and describes the volatilization of dissolved organic solutes from water.

In the subsurface, transport of volatile organics in the gas phase occurs when the VOCs partition from the liquid phase to the gas phase. The primary mechanism affecting gas-phase transport is diffusion. The transport of volatile organics through the soil-gas phase also will be affected by adsorption to soil, dissolution into water and biodegradation. Based on the Henry's Law constants for benzene and sulfolane, benzene is expected to volatilize while sulfolane volatilization from groundwater is not expected to occur.

Volatilization from groundwater and the subsequent mass transport of these vapors into indoor spaces constitute a potential inhalation exposure pathway. The Johnson and Ettinger model was used to assess

this potential exposure pathway at the Facility. Based on the modeling results, risk-based concentrations (RBCs) were derived. Groundwater data were then compared to these RBCs (details of this modeling effort are provided in Appendix D).

5.2.6   Dispersion and Diffusion

Dispersion is present as either hydrodynamic or mechanical. Hydrodynamic dispersion is the process whereby a contaminant plume spreads out in directions that are longitudinal and transverse to the direction of plume migration. Mechanical dispersion is the mixing that occurs as a result of local variations in velocity around some mean velocity of flow. With time, a given volume of solute will gradually become more dispersed as different portions of the mass are transported at differing velocities. Molecular diffusion occurs when concentration gradients cause solutes to migrate from zones of higher concentration to ones of lower concentrations, even in the absence of groundwater flow. Molecular diffusion only plays a role at low groundwater velocities.

At the Facility, hydraulic conductivity values are relatively high and the orientation of sand deposits in the upper alluvial aquifer play the dominant role in governing the migration of contaminants. Therefore, diffusion and dispersion likely exert only minor effects on contaminant migration.

5.3   Summary of Analysis

The following observations are made regarding contaminant fate and transport at the Facility:

- Actual benzene migration is governed by the orientation of sand channels that terminate in fine-grained deposits of silt and clay. Additionally, benzene is actively degraded through biological processes, methanogenesis in particular.

- Although sulfolane behavior in the natural environment is not as well understood as benzene behavior, it is observed that sulfolane migration in the upper alluvial aquifer is also governed by the orientation of sand channels that terminate in fine-grained deposits of silt and clay. In the lower alluvial aquifer, there may also be variations in hydraulic conductivity that reduce the migration of sulfolane relative to that predicted.

It should be noted that migration and fate of both benzene and sulfolane, as well as other contaminants in groundwater, are influenced by the active application of interim measures. As mentioned previously, CPCPRC has been implementing EFR and VISM since 1996. These measures, along with the natural attenuation processes work to reduce contaminant mass and influence contaminant extent, fate and transport.

6. BASELINE RISK ASSESSMENT

As mentioned previously, CPCPRC performed extensive risk assessment as part of the RFI activities and submitted the Final Risk Characterization Report (CPCPRC, 2004). This HHRA represents an update of potential risk and provides an analysis of the current potential risk using current toxicity data, the extensive investigation data collected during the AOC Investigation, current groundwater quality data and current Effluent Channel surface water and sediment quality data.

In accordance with risk assessment guidelines, this HHRA considers conservative but reasonable exposure scenarios. The receptor groups evaluated are based on current and potential future site-specific uses. The AOC investigation focused on the 19 AOCs as potential contaminant sources and the potential receptors are equally likely to be exposed any of the 19 AOCs. Considering this, the AOC data were considered collectively to formulate a site-wide, comprehensive assessment of potential risk.

In addition to the HHRA, CPCPRC performed a Screening Level Ecological Risk Assessment. The SLERA was performed in accordance with the EPA guidance (EPA, 1997), *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments*. The EPA Region4, 5 and 6 ecological screening levels (ESL) were used for a sample-by-sample comparison.

6.1 Human Health Risk Assessment

The objective of a baseline HHRA is to analyze the potential "baseline risk" (i.e., the risk that could occur if no action were taken to remediate the site) under current and potential future land use conditions. The methodology and technical approach for performing the HHRA was based on applicable EPA guidance documents (EPA, 1986, 1988 a and b, 1989, 1991, 1992, 1994, 1996 a and b, 1997a, 2001, 2002 and 2004).

6.1.1 Data Evaluation and Identification of COPCs

The analytical data were validated by a Puerto Rico certified chemist, using the EPA Region 2 data validation guidelines. The data validation reports are presented in Appendix E. No data were rejected during data validation. The detections for the inorganic constituents were qualified as estimated due to matrix spike recoveries being outside the accuracy range or the duplicate precision being outside the precision limit. The estimated data are considered usable for risk assessment and the reported positive data (detected values) were used as in risk assessment.

The analyses were performed using the EPA-approved analytical methods. The field duplicate and blank data indicated that the sampling and laboratory cleaning procedures were implemented consistently and properly.

As described in Section 4.1, the analytical data were compared to site-specific RBSLs. If a chemical was detected even once above a media-specific RBSL, that chemical was carried forward as a COPC in the risk assessment.

6.1.2 Exposure Assessment and Site-Specific Exposure Model

The conceptual exposure model for the site describes the potential sources of contamination, contaminant types, potential receptor populations and exposure pathways for the current and potential future receptors. The components of the conceptual exposure model are discussed below and presented graphically in Figure 6-1.

6.1.2.1   Contaminant Sources

During the period that the Facility was active, CPCPRC processed naphtha into light hydrocarbon products, including BTEX. The feedstocks, intermediates, process chemicals and end-products were stored in ASTs. Inadvertent releases of materials from the storage tanks into the surrounding soil occurred intermittently during the operational period of the Facility.

6.1.2.2   Contaminant Types

As shown in Section 4, VOCs, specifically BTEX and the process chemical sulfolane (a semi-volatile organic compound), were the most frequently detected contaminants. Incidental heavier fuel components, such as the polynuclear aromatic hydrocarbons (PAH) were also detected but less frequently. Although metals where frequently detected, only 5 metals were found above background levels in site samples.

6.1.2.3   Potential Receptors

The receptors and exposure pathways are presented graphically in Figure 6-1, and summarized in the following subsections.

Resident

Currently, there are residents south of the Facility in the community of Las Mareas and this condition is expected to remain in the future. There are currently no residents on the site and no residents are expected to live on site in the future.

The offsite resident is assumed to be exposed to groundwater via a drinking water well. It is likely for a hypothetical drinking water well to intercept both the upper and lower alluvial aquifers; therefore, the data for the two aquifers were combined for risk assessment. No dilution or attenuation of the contaminant concentrations was assumed for offsite migration of groundwater.

The groundwater contact would include direct ingestion, dermal contact and inhalation of vapors emanating from the household usage of the groundwater. These exposure routes were quantitatively evaluated for assessing the potential risk to the resident.

As another level of conservatism, the noncarcinogenic risks were evaluated for a resident child. The resident child was used because based on the intake, body weight and exposure duration factors the child is more susceptible to the noncarcinogenic risks than an adult resident. The carcinogenic risks were evaluated for an age-adjusted resident; a person who grows up on the site as a child and then lives at the site as an adult.

Construction Workers

Construction is plausible and during the course of construction activities, the construction worker would be potentially exposed to both surface and subsurface soil. Additionally, the construction worker could be exposed to groundwater if groundwater were encountered within the excavation depths.

Exposure to surface soil as well as the subsurface soil is considered and the data for these media were combined. On the other hand, the groundwater exposure is only plausible for the upper alluvial aquifer groundwater. This is because the lower alluvial aquifer is at a depth of 25 ft or more bgs and excavation to these depths is not likely.

Incidental ingestion of and dermal contact with soil, and inhalation of particulates and vapors pathways were evaluated for exposure to soil. Dermal contact and inhalation of vapors pathways were evaluated for exposure to groundwater.

Industrial Workers

Currently, a limited number of workers remain on the site. Additionally, future industrial activity at the site is plausible. Therefore, an industrial worker was evaluated in the risk assessment.

The industrial worker does not typically perform intrusive work; therefore, the exposure was limited to surface soil. Exposure to subsurface soil, groundwater, surface water and sediment were considered to be incomplete exposure pathways.

The incidental ingestion of soil, dermal contact with soil and inhalation of particles and vapors were evaluated as the exposure routes.

Trespassers

The Facility is gated and guarded 24/7 and will remain so in the future. However, current and future trespassing on the site was conservatively considered plausible. A child age 6 to 18 years was assumed to trespass the site for recreational purposes. Exposure to surface soil, surface water and sediment were considered plausible. Ingestion, dermal contact and inhalation pathways were evaluated quantitatively.

Table 6-1 presents a summary of the intake parameters used in the calculation of the site-specific RBSLs. The parameters include both default parameters taken from EPA guidance documents and site-specific parameters.

6.1.3   Calculation of Exposure Point Concentrations

In accordance with risk assessment guidance, the exposure point concentration (EPC) represents the concentration of a chemical in the exposure media. The representative concentration is statistically calculated from the data points, based on the range of values, variability, distribution pattern, etc.

There are two types of exposure estimates currently identified for use in risk assessments: a reasonable maximum exposure (RME) and a central tendency exposure (CTE). The RME is the maximum exposure that is reasonably expected to occur for a given exposure pathway at a site, and is intended to account for both uncertainty in the contaminant concentration and variability in the exposure parameters. As a conservative measure, the RME scenario was evaluated in this HHRA. This approach is conservative because the RME is based on the upper bound estimates of the input parameters.

Because of the uncertainty associated with characterizing contamination in environmental media, the upper confidence limit (UCL) on the arithmetic mean chemical concentration is usually determined for each COPC and each medium. This is defined as the 95 percent (%) UCL or 95UCL.

The EPA ProUCL version 4.1 statistical software was used to determine the 95UCLs. The software performs several statistical tests on data and calculates one or more 95UCLs. The software takes into account all detected and non-detected values in the 95UCL calculations. Unlike the previous versions of ProUCL in which the non-detected values were considered detected at one-half the reported result, in ProUCL version 4.1 the detects and non-detects are assigned "1" and "0" flags without changing the reported values.

The 95UCLs were calculated for the individual and combined media, as appropriate for the specific receptors. For soil and groundwater, the 95UCLs are the EPCs.

It is noted here that the 95UCL calculation was not valid for the effluent channel surface water and sediment. This is because the number of data points was insufficient (only three samples of each medium). For this reason, the EPC for the chemicals that were detected in effluent channel surface water and sediment are the maximum detected value for that chemical.

The EPCs and basis for EPC are presented in Table 6-2. The detailed outputs from the ProUCL software are presented in Appendix C.

6.1.4 Toxicity Assessment

The Modified Skinner List of chemicals are classified into two broad categories: carcinogens and noncarcinogens. This classification is used because separate toxicity values are used and potential health risks are calculated differently for carcinogenic and noncarcinogenic effects. Data from toxicity studies with laboratory animals or from epidemiological studies of human populations were used to develop the toxicity values. In the risk characterization step, toxicity values are combined with exposure intakes to develop numerical estimates of carcinogenic health risks for carcinogenic chemicals and hazard indices (HIs) for noncarcinogenic chemicals.

The oral toxicity values (cancer slope factors [SF] and reference doses [RfDs]), inhalation toxicity values (unit risk factors [URFs]), and reference concentrations (RfCs) used in the risk assessment were obtained from the following sources (in order of hierarchy):

- **Integrated Risk Information System (IRIS).** Database available online through the National Center for Environmental Assessment (NCEA) in Cincinnati, Ohio. EPA regularly maintains IRIS. The IRIS data used in this risk assessment are current as of the writing of this report (March 2013).

- **Health Effects Assessment Summary Tables (HEAST).** Compilation of toxicity values published in various health effects documents issued by the EPA Office of Solid Waste and Emergency Response (OSWER). The HEAST data are current as of the writing of this report (March 2013).

- **Provisional Peer-reviewed Toxicity Values (PPRTV).** Developed for the EPA OSWER Office of Superfund Remediation and Technology Innovation (OSRTI) programs. These values are current as of the writing of this report (March 2013).

- **Other Sources.** Oak Ridge National Laboratory periodically searches and maintains toxicity values in their Risk Assessment Information System (RAIS) database on behalf of EPA. This source was used to retrieve the missing toxicity. These values are current as of the writing of this report (March 2013).

Dermal toxicity values are generally not provided in these sources. The dermal toxicity values were calculated using EPA's Final Risk Assessment Guidance for Superfund, Volume I – Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment (EPA, 2004).

6.1.4.1 Non-Carcinogenic Toxicity Information

Estimates of noncarcinogenic effects are evaluated using RfDs (oral and dermal exposures) and RfCs (inhalation exposures). The RfD and RfC are threshold values based on specific toxic effects. In general, the RfD or RfC is an estimate (with uncertainty of an order of magnitude or more) of a daily exposure to

the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime of exposure.

6.1.4.2   *Carcinogenic Toxicity Information*

Evidence of carcinogenicity of a chemical comes from two sources: lifetime studies with laboratory animals and/or human studies where potential cancer risk is associated with chemical exposure. Unless there is evidence to the contrary, if a carcinogenic response occurs at the exposure levels studied (typically high doses), it is conservatively assumed that carcinogenic responses can occur at all lower doses. Exposure to any level of a carcinogen is assumed to have the potential to induce cancer (i.e., no toxic threshold exists).

Because potential risks at low levels of exposure cannot be quantified directly by either animal or epidemiological studies, mathematical models are used to extrapolate from high to low doses. The linearized multistage model for low dose extrapolation is recommended by regulatory agencies. Use of the linearized multistage model leads to a conservative upper-bound estimate of potential risk. The linearized multistage model incorporates a procedure for estimating the 95UCL on the maximum likelihood estimate of the slope. Often the most sensitive animal species studied is used for extrapolation to humans (i.e., humans are assumed to be as sensitive as the most sensitive animal species tested). Given the conservative nature of the approach for estimating health risks for carcinogens, the actual risk is likely to be lower than the estimate calculated using these assumptions, and could be zero.

Numerical estimates of potential cancer potency for a chemical are provided as SFs (for ingestion and dermal exposures) or URFs (for inhalation exposures). Assuming dose-response linearity at low doses, SFs and URFs define the potential incremental lifetime cancer risk (ILCR) from a continuous lifetime exposure to the carcinogen. SFs and URFs are expressed in units of potential risk per milligrams per kilogram-day (mg/kg-day) and as risk per microgram per cubic meter ($\mu g/m^3$) in inhaled air, respectively.

Each SF and URF is accompanied by a weight-of-evidence classification, which considers the available data for a chemical in evaluating the likelihood that the chemical is a potential human carcinogen. The evidence is characterized collectively for studies in humans and studies in laboratory animals as sufficient, limited, inadequate, no data, or evidence of noncarcinogenicity. EPA has recommended that cancer risk estimates be accompanied by a weight-of-evidence classification to indicate the strength of evidence that a chemical is a human carcinogen.

6.1.5   Quantifying Chemical Intake

The chemical intake considers the specific receptors, exposure route and the EPC to derive the dosage term of chemical daily intake (CDI). The CDI is expressed as the daily intake per unit of body weight. The most common unit for CDI is mg/Kg-day; i.e., milligrams per day per Kilogram of body weight.

The CDI equations take the following general form. There may be nuances to the equations depending on the scenario; the specific equations are shown on the detailed calculations sheets in the Section 6 risk assessment tables.

Ingestion CDI	=	EPC*IR*EF*ED*0.000001/BW/AT/365
Dermal CDI	=	EPC*SA*AF*ABS*EF*ED*0.000001/BW/AT/365/GI_Factor
Inhalation IC	=	EPC*(1/PEF+1/VF)

Inhalation CDI   =   IC*IR*EF*ED/BW/AT/365

Where:

CDI	=	chemical daily intake (mg/Kg-day)
EPC	=	exposure point concentrations (mg/Kg or mg/L)
IR	=	Intake rate (mg/day or L/day or M^3/day)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
BW	=	body weight (Kg)
AT	=	attenuation time (years)
SA	=	skin area (cm^2)
AF	=	skin adherence factor (mg/cm^2)
ABS	=	absorption factor (unitless)
GI_Factor	=	gastro-intestinal absorption factor (unitless)
IC	=	inhaled concentration (mg/M^3)
PEF	=	particulate emission factor (mg/M^3)
VF	=	volatilization factor (mg/M^3)

The risks are then quantified using the following equations:

HI	=	CDI/RfD; and
ILCR	=	CDI x SF

Where:

RfD	=	noncarcinogenic reference dose (mg/Kg-day)
SF	=	carcinogenic slope factor (Kg-day/mg).

6.1.6   Risk Characterization

Risk characterization involves estimating the magnitude of potential adverse health effects from exposure to COCs. This estimation is accomplished by combining the estimated intakes (exposure levels) and toxicity factors to provide numerical estimates of ILCR for the potential carcinogenic health risks and HIs for the noncarcinogenic health risks. Risk characterization also considers the nature and weight of evidence supporting these estimates, as well as the magnitude of uncertainty surrounding the estimates.

For this HHRA, risks from media-specific COPCs (Table 4-72) were calculated for each receptor and for each applicable media exposure. The risks for these scenarios are summarized below. The risk quantification included calculating the carcinogenic and noncarcinogenic risks for each exposure route applicable to an exposure media and then adding the risks from all exposure media applicable to a receptor. As a result, cumulative risks for a receptor exposed to the plausible exposure media and pathways were calculated.

The discussion below is organized by the receptor type and for each receptor the media-specific potential risks are discussed, followed by cumulative risks. The common EPA National Contingency Plan (NCP) barometers of noncarcinogenic risk, hazard index (HI), not exceeding 1 and the carcinogenic risk, ILCR, no greater than 1×10^{-4} (1 incident per 10,000 persons) are used to describe potential excess risk (if any).

6.1.6.1 Resident

As discussed earlier, the resident was assumed to be exposed to the combined upper alluvial and lower alluvial aquifer groundwater.

The cumulative risk summary for the resident is provided in Table 6-3. The detailed pathway risk calculations are presented in Table 6-4 (combined groundwater; noncarcinogenic risk) and Table 6-5 (combined groundwater; carcinogenic risk).

Cumulative Risk. The cumulative risks for the resident are presented in Table 6-3. Note that it is customary to present the potential risk with zero decimals. The % contributions as shown are actual percentages; they may not be exactly calculable using the truncated risk numbers on the table.

The total noncarcinogenic HI is 500 and the ILCR is 3×10^{-2} or 3 cancer incidents per 100 persons. Both risk indices are significantly above the acceptable NCP departure points of HI =1 and ILCR not exceeding 1×10^{-4}.

Ingestion of groundwater and inhalation of the vapors account for 94% of the noncarcinogenic risk (53% and 41%, respectively). Dermal pathway contributes the remaining 6% of the noncarcinogenic risk. Ingestion and inhalation pathways also contribute 92% of the carcinogenic risk (37% and 56%, respectively), with the dermal pathway contributing the remaining 8% of the carcinogenic risk.

Groundwater Pathways. The groundwater noncarcinogenic risks are presented in Table 6-4. Seven chemicals, arsenic, cobalt, sulfolane, benzene, ethylbenzene, m- & p-xylene, and o-xylene exceed the HI of 1. Benzene accounts for 80%, and sulfolane accounts for 14% of the total HI of 500. The majority of the noncancer risk results from ingestion of groundwater and inhalation of groundwater vapors.

The groundwater carcinogenic risks are presented in Table 6-5. Of the 14 carcinogenic chemicals, 11 exceed the single chemical ILCR benchmark of 1×10^{-6}. Approximately 56% of the cancer risk results from the inhalation of vapors and 37% of the cancer risk results from the ingestion of groundwater. Benzene accounts for 94% of the groundwater cancer risk.

Risk Summary for Resident. In summary, for the residential scenario, the combined groundwater poses both carcinogenic risk and non-carcinogenic risk. Benzene accounts for over 90% of the groundwater carcinogenic risk and 80% of the noncarcinogenic risk.

6.1.6.2 Construction Worker

As discussed earlier the construction worker was assumed to be exposed to the combined surface soil and subsurface soil and to upper alluvial aquifer groundwater.

The cumulative risk summary for the construction worker is provided in Table 6-6. The detailed pathway risk calculations are presented in Table 6-7 (combined soil; noncarcinogenic risk), Table 6-8 (combined soil; carcinogenic risk), Table 6-9 (upper alluvial groundwater; noncarcinogenic risk), and Table 6-10 (upper alluvial groundwater; carcinogenic risk).

Cumulative Risk. The cumulative risks for the construction worker are presented in Table 6-6. The total noncarcinogenic HI is 20 and the ILCR is 2×10^{-4} or 2 cancer incidents per 10,000 persons. Both risk indices are above the acceptable NCP departure points of HI =1 and ILCR not exceeding 1×10^{-4}. The table also shows that practically all risks (87% of noncancer risk and 99% of cancer risk) arise from exposure to groundwater. The soil risks are negligible relative to the groundwater risks; however, soil cumulative HI of 3 is above the NCP threshold. The soil carcinogenic ILCR of 1×10^{-6} is within the NCP acceptance range.

Dermal contact with groundwater is the major contributor to the noncarcinogenic risk (57% of total HI) and carcinogenic risk (86% of total ILCR). Inhalation of groundwater vapors results in 30% of the total noncarcinogenic risk and 13% of the carcinogenic risk.

Soil Pathways. Table 6-7 (for noncarcinogenic effects from soil) indicates that sulfolane with an HI of 1 (42% of total HI) is the only chemical exceeding the HI benchmark. Ingestion of soil results in 39% of the soil noncarcinogenic risk, dermal contact with soil results in 16% of the soil noncarcinogenic risk and inhalation of particulates and vapors from soil results in 45% of the soil noncarcinogenic risk.

Table 6-8 (for the soil carcinogenic effects) indicates 7,12-dimethylbenz(a)anthracene as the only chemical at or above the single chemical threshold of 1×10^{-6}. There was only one detection of 7,12-dimethylbenz(a)anthracene out of 518 samples. Inhalation of particulates and vapors from soil is the primary exposure pathway.

Groundwater Pathways. The groundwater noncarcinogenic risks are presented in Table 6-9. Three chemicals, cadmium with an HI of 2 (11% contribution), hexavalent chromium with an HI of 6 (30% contribution) and benzene with an HI of 8 (40% contribution) exceed the HI threshold. The risks result from dermal contact with groundwater (66%) and inhalation of vapors (34%).

The groundwater carcinogenic risks are presented in Table 6-10. Three chemicals, arsenic (ILCR of 5×10^{-6} or 3% of total ILCR), hexavalent chromium (ILCR of 1×10^{-4} or 80% of total ILCR) and benzene (ILCR of 3×10^{-5} or 16% of total ILCR) were above the single chemical threshold. Dermal contact with water is the predominant contributor (86% of the total ILCR) to the groundwater carcinogenic risk.

Risk Summary for Construction Worker. In summary for the construction worker scenario, the combined soils are posing only a marginal risk from sulfolane (noncancer risk) and 7,12-dimethylbenz(a)anthracene (cancer risk). The upper alluvial groundwater is posing a relatively higher noncancer risk from cadmium, hexavalent chromium and benzene. The cancer risk from groundwater is a factor of two above the NCP departure point due primarily to hexavalent chromium, with benzene and arsenic as minor contributors.

6.1.6.3   Industrial Worker

As discussed earlier the industrial worker was assumed to be exposed to the surface soil only. The worker is not exposed to subsurface media such as the soil and groundwater below 2 ft depth.

The cumulative risk summary for the industrial worker is provided in Table 6-11. The detailed pathway risk calculations are presented in Table 6-12 (surface soil; noncarcinogenic risk) and Table 6-13 (surface soil; carcinogenic risk).

Cumulative Risk. The cumulative risks for the industrial worker are presented in Table 6-11. The total noncarcinogenic HI is 1. The ILCR is 5×10^{-6} or 5 cancer incidents per 1,000,000 persons. Both risk indices are within the NCP departure points of HI =1 and ILCR not exceeding 1×10^{-4}.

Soil Pathways. Table 6-12 (for noncarcinogenic effects from soil) indicates the individual pathway and cumulative HIs for all chemicals. Sulfolane at an HI of 1 is the primary noncancer risk contributor in soil (84% of the total HI).

Table 6-13 (for the soil carcinogenic effects) indicates arsenic (ILCR of 3×10^{-6} or 56% of total ILCR) and ethylbenzene (ILCR of 1×10^{-6} or 23% of total ILCR) as the only chemicals above the single chemical threshold of 1×10^{-6}. The risk from arsenic arises primarily through ingestion of soil, while the

risk from ethylbenzene arises primarily from inhalation of vapors. The background comparison presented earlier indicates arsenic is naturally occurring.

Risk Summary for Industrial Worker. In summary for the industrial worker scenario, the surface soil is posing only a marginal cancer risk from arsenic and ethylbenzene. The individual chemical risks are above the single chemical threshold but cumulative carcinogenic risk is below the NCP departure point.

6.1.6.4   *Trespasser*

As discussed earlier the trespasser was assumed to be exposed to the surface soil, and surface water and sediment in the effluent channel.

The cumulative risk summary for the trespasser is provided in Table 6-14. The detailed pathway risk calculations are presented in Table 6-15 (surface soil; noncarcinogenic risk), Table 6-16 (surface soil; carcinogenic risk), Table 6-17 (effluent channel sediment; noncarcinogenic risk), and Table 6-18 (effluent channel sediment; carcinogenic risk). There were no exceedances of the RBSL in surface water; therefore, risk quantification for surface water was unnecessary.

Cumulative Risk. The cumulative risks for the trespasser are presented in Table 6-14. The total noncarcinogenic HI is 1 and the ILCR is 1 x 10-6 or 1 cancer incidents per 1,000,000 persons. The noncancer risk and the cancer risk are within the NCP risk acceptance limits of HI = 1 and ILCR no greater than 1 x 10-4.

Exposure to surface soil accounts for 53% of the total noncancer risk and 89% of the cancer risk. Surface water contributes 44% of the total noncancer risk, but no cancer risk contribution. Sediments contribute 3% of the total noncancer risk and 11% of the cancer risk.

Dermal contact with soil and surface water are the primary noncancer risk pathways, while inhalation of soil particulates and vapors, and ingestion of soil are the primary cancer risk pathways.

Soil Pathways. Table 6-15 (for noncarcinogenic effects from soil) indicates that the individual chemical risks and the cumulative risk are below the HI benchmark. Sulfolane with an HI of 0.4 (78% of total HI) and m- & p-xylene with an HI of 0.07 (12% of total HI) are the primary contributors to the noncarcinogenic risks; however, the risks are below the HI benchmark. The sulfolane risks arise primarily through the dermal contact pathway, while the m- & p-xylene risk results from inhalation of particulates and vapors from soil.

Table 6-16 (for the soil carcinogenic effects) indicates the individual chemical risks and the cumulative risks from soil are the single chemical threshold of 1 x 10^{-6} and the cumulative threshold of 1 x 10^{-4}. From a contribution perspective, ethylbenzene, arsenic and benzene are the primary risk contributors. The background comparison presented earlier indicates arsenic is naturally occurring.

Effluent Channel Sediment Pathways. Table 6-17 (for noncarcinogenic effects from sediment) indicates that the individual and cumulative HIs for sediment are acceptable. Similarly, Table 6-18 indicates that the cancer risks from sediment are acceptable.

Effluent Channel Surface Water Pathways. Table 6-19 (for noncarcinogenic effects from surface water) indicates that the individual and cumulative HIs for sediment are acceptable. Similarly, Table 6-20 indicates that the cancer risks from surface water are acceptable.

Risk Summary for Trespasser. In summary for the trespasser scenario, there are no unacceptable risks from surface soil, sediment and surface water.

6.1.7 HHRA Summary

The following provides a summary of the HHRA results presented above.

6.1.7.1 Resident HHRA Summary

For the resident, the cumulative noncancer risk is demonstrated by an HI of 500, while the cancer risk is 3×10^{-2}. Both of these values are outside the acceptable risk ranges.

For the resident, benzene is the risk driver and the majority of the cancer (94% of the total) and noncancer risk (80% of the total) would result from exposure to benzene in groundwater. Ethylbenzene, m- & p-xylene, o-xylene and sulfolane are minor contributors to the noncancer risk.

Ingestion of groundwater and inhalation of groundwater vapors are the primary routes for the noncancer risk for the resident, while inhalation of vapors and ingestion of groundwater are the dominant routes for the cancer risk.

6.1.7.2 Construction Worker HHRA Summary

The construction worker would be at potential risk while working in soil and upper alluvial aquifer groundwater. The majority of the cancer and noncancer risk would result from contact with groundwater. The cumulative HI is 20 while the cancer risk is 2×10^{-4}. Both of these values are outside the acceptable risk ranges. For the construction worker, potential cancer risk is a result of exposure to benzene in groundwater. Benzene, cadmium and hexavalent chromium contribute to potential noncancer risk from groundwater.

Dermal contact and inhalation of vapors are the primary routes for the cancer risk as well as the noncancer risk.

6.1.7.3 Industrial Worker

The cumulative risks for the industrial worker are within the NCP acceptance ranges; the cumulative HI of 1 and cumulative cancer risk of 5×10^{-6} are at or below the NCP departure points of HI of 1 and ILCR no greater than 1×10^{-4}.

6.1.7.4 Trespasser

The cumulative risks for the trespasser are within the NCP acceptance ranges; the cumulative HI of 1 and cumulative cancer risk of 5×10^{-6} are at or below the NCP departure points of HI of 1 and ILCR no greater than 1×10^{-4}.

6.1.8 Risks from Vapor Intrusion

The risks from soil and groundwater vapor intrusion in a hypothetical residential dwelling and in office buildings were estimated separately. Appendix D presents the details of the Johnson and Ettinger Model that was used for vapor intrusion modeling, and the results.

Two onsite receptors (a resident and an industrial worker) and two offsite receptors (a worker in the AES administration building and a worker in the AES shed near CPCPRC's southwest property boundary)

were evaluated. The onsite receptors were evaluated for vapor inhalation risks from soil as well as groundwater. The offsite receptors were evaluated for groundwater vapor inhalation risks only since the soil contamination is limited to the AOCs identified on CPCPRC .

The vapor intrusion risks are summarized in the box below. Details can be found in Appendix D. Potential unacceptable risks are indicated for the hypothetical onsite resident and Industrial worker. Benzene and ethylbenzene are the primary risk contributors (See Appendix D). As determined in the HHRA, these chemicals also could pose unacceptable risk from direct exposure to the media. For the AES worker, the conservative calculations indicate there is no expected excess risk.

Receptor	Media	Total ILCR	Total HI
Onsite Resident	Soil and Groundwater	**8.E-04**	**8.E+00**
Onsite Worker	Soil and Groundwater	**2.E-04**	**2.E+00**
AES Administration Worker	Groundwater	3.E-05	4.E-01
AES Shed Worker	Groundwater	4.E-05	4.E-01
HI = hazard index ILCR = Incremental lifetime cancer risk			

6.2 Screening Level Ecological Risk Assessment

The Screening-Level Ecological Risk Assessment (SLERA) was performed to assess the potential impacts to ecological receptors from contaminants detected at the site. The media considered for SLERA include surface soil, and effluent channel surface water and sediment. The surface soil data from the AOC investigation, and the effluent channel surface water and sediment data collected in May/June 2012 and in December 2012 were used in the SLERA.

It should be noted that CPCPRC performed ecological risk assessment as part of the RFI activities and submitted the findings in the Final Risk Characterization Report (CPCPRC, 2004). This SLERA represents an update of potential risk and provides an analysis of the current potential risk using current ecological screening levels and current surface water and sediment data collected from the Effluent Channel in May/June 2012 and in December 2012.

The SLERA included a sample-by-sample comparison of the analytical results with the ecological screening levels (ESLs). The ESLs are screening levels compiled by EPA and these values were used to identify the chemicals of potential concern (COPCs) for the ecological receptor. The lowest of the ESLs compiled by the EPA Regions 4, 5 and 6 were used for screening the sample data.

The general statistics for the ecological exceedances by media is shown in Table 6-21.

6.2.1 Surface Soil

A total of 259 surface soil samples were analyzed for the modified Skinner list chemicals. As seen in Table 6-21, a total of 31 chemicals exceeded the ESLs, including 15 metals/inorganics, nine SVOCs and, seven VOCs. The table also includes the EPCs for the detected chemicals, and the background metal concentrations in surface soil.

As shown in Table 6-21, the metals exceed ESLS in most cases; however, with the exception of lead, the metal EPCs are below the background levels. The lead EPC of 19,367 µg/Kg is only slightly above the background concentration of 15,000 µg/Kg. Table 6-21 also indicates that the background metals

concentrations are also in exceedance of the ESLs. Based on these observations, the metals in the surface soil pose no additional ecological risk above the background risks.

The nine SVOCs have a low detection and exceedance frequency in relation to the number of samples. Of particular interest are the five PAHs (anthracene, benzo(a)pyrene, fluoranthene, naphthalene and, pyrene) which have only one to three exceedances out of 259 samples, with the exception of naphthalene which has 15 exceedances. Only the anthracene and naphthalene EPCs are in excess of the ESL, but by less than a factor of two. Anthracene has only one exceedance. Two phenolic SVOCs (phenol and 2,4-dimethylphenol) EPCs exceed ESLs, with the phenol EPC being less than two times the ESL, and the 2,4-dimethylphenol EPC being five times the ESL. The remaining two phthalate SVOCs are most likely common laboratory contaminants.

Most of the VOC EPCs are significantly above the ESLs. These VOCs are also present at unacceptable levels based on the HHRA.

In summary, the surface soils have a potential to pose unacceptable ecological risks from VOCs.

6.2.2   Effluent Channel Sediment

Three to six sediment samples were analyzed for the modified Skinner chemicals. Five chemicals, all metals exceeded the ESL (Table 6-21). With the exception of sulfolane, organic compounds were not detected in the sediment. There is no EPA Regional ESL for sulfolane.

6.2.3   Effluent Channel Surface Water

Three to six surface water samples were analyzed for the modified Skinner chemicals. Six metals were detected; three metals barium, manganese and vanadium exceeded the surface water ESLs (Table 6-21).

6.2.4   Ecological Screening Summary

Potential ecological risks are indicated through the conservative screening analysis. Further formulation of the problem and potentially a quantitative ecological risk assessment (ERA) is not considered warranted since corrective measures may be implemented for the surface soil to control the human health risks, and the Effluent Channel is a candidate for closure in the near future. Closure of the channel will include removal of the water and sediment and backfilling. The Effluent Channel closure will constitute the corrective measure to address the ecological risk by eliminating the media or access to them.

6.3   Uncertainty Analysis

This section presents a discussion of the uncertainties associated with the estimates of potential health risk provided in this baseline HHRA. The following subsections discuss uncertainty with respect to the four steps of the HHRA process.

6.3.1   Uncertainties Related to Hazard Identification

The purpose of data evaluation is to determine which chemicals, if any, are present at the site at concentrations warranting quantification of risk. Uncertainty with respect to data evaluation is associated with many sources, such as the quality of data used to characterize the site and the process to select the data for evaluation in the HHRA.

The screening process used to select COCs for evaluation in the HHRA was intended to include all chemicals with concentrations high enough to be of concern for the protection of public health. Because the COC screening procedure used the lowest of scenario-specific RBSLs to compare even a single

detection out of hundreds of samples, the COC selection process was conservative so that potential sources of public health threats were not overlooked.

The COC selection process also included an evaluation of analytical detection limits (DLs) to ensure that chemicals could be detected at concentrations of concern. There were some chemicals that were not detected in any samples and had the DLs that exceeded the RBSLs. In other words, if these chemicals did exist at concentrations above the RBSLs, the analytical methods were not sensitive enough to detect the chemicals. These chemicals are presented in Appendix B. The constituents are heavier PAHs, chemicals with hetero-atom functionality (i.e., nitro functionality) or chemicals with high boiling points. Many of the chemicals are not to be expected from the petroleum processing operations. Had these constituents been expected in the sampling media, there should be an expectation of finding a detectable concentration in the over 500 samples analyzed. Therefore, the DLs do not have an adverse impact on risk assessment.

6.3.2   Uncertainties Related to Naturally Occurring Metals

CPCPRC has presented the soil cumulative risks inclusive and exclusive of the metals determined to be naturally occurring through comprehensive statistical evaluations. The risk from naturally occurring metals results in an overestimation of risk.

The metals risks for the three receptors resulting from the soil pathways were calculated with and without the metals determined to be naturally occurring (Appendix B). It is seen from the table that when the background metal risks are excluded, the risks from the remaining metals are acceptable.

6.3.3   Uncertainties Related to Exposure Assessment

In identifying potentially complete exposure pathways for the HHRA, assumptions were made about current and future activities that occur in on site. These assumptions may result in an over- or under-estimation of risk depending on what actual activities occur in this area.

The quantification of exposure consists of two basic steps: estimation of potential EPCs and estimation of potential human intake. Potential sources of uncertainty associated with these two steps are discussed below.

6.3.4   Estimation of Exposure Point Concentrations

The objective of a baseline risk assessment is to estimate risks associated with average exposure over an area that is contacted on a daily basis (i.e., exposure area). The EPC is used to represent the average concentration for the COCs in an exposure area. Uncertainties associated with these EPCs may be due to uncertainties in the data set or the statistical protocols followed to calculate the EPCs.

The EPA's ProUCL software was used to calculate the EPCs. When the frequency of real data; i.e., detections, is high, representative EPCs are calculated. However, if the majority of the data are non-detects, the EPCs may not be representative. The direction of the bias in the EPCs is not predictable; however, the ProUCL software is programmed to err on the safe side; i.e., the EPCs may be overestimated.

Also a simplifying assumption was made that EPCs remain constant for the duration of exposure. Physical, chemical, or biological processes that could reduce chemical concentrations over time were not factored into the estimates of the EPCs. Use of this conservative assumption likely contributes to an overestimation of exposure.

6.3.5 Estimation of Potential Intake

When estimating potential human intakes (i.e., doses) from theoretical exposures through various pathways, several assumptions are made. Uncertainty is associated with assumptions concerning rates of ingestion, frequency and duration of exposure, and bioavailability of the chemicals in the medium. Whenever possible, site-specific information was used in the HHRA to establish the exposure assumptions used in the risk calculations.

However, for some scenarios, site-specific information is not considered and standard default assumptions of intake are used. Typically, when site-specific information is not available to establish these assumptions, conservative (i.e., health-protective) estimates of potential exposure are used (e.g., EPA default values) that may result in overestimates of risk. For example, it is unlikely that the industrial workers will be present outdoors only for the entire career of 25 years.

For the exposure pathway involving potential exposure of construction workers to groundwater through the dermal contact route, the current EPA methodology (EPA, 2004) was used to calculate a dermal absorbed dose per exposure event (DA$_{event}$). This value is estimated to be the total dose dissolved in the skin at the end of the exposure time. For highly lipophilic compounds or for chemicals that exhibit a long lag time, some of the chemical dissolved in the skin may be lost due to desquamation of skin cells during that absorption period and consequently, the calculated DA$_{event}$ value may overestimate the amount of chemical actually absorbed. A fraction absorbed term (FA) was included in the calculation of the permeability constant (PC) and DA$_{event}$ to account for this loss of chemical through desquamation.

6.3.6 Uncertainties Related to Toxicity Information

The concentration of COCs to which people are potentially exposed in an environmental setting is usually much less than the concentrations used in the studies from which dose-response relationships are developed. Estimating potential health effects from environmental exposures, therefore, requires the use of models that allow extrapolation of health effects from high experimental doses (where effects can be measured) to low environmentally relevant doses. These models contain conservative assumptions that have uncertainties associated with them.

Uncertainties are associated with estimated noncarcinogenic toxicity values. For many noncarcinogenic effects, protective mechanisms are believed to exist in the human body that must be overcome before an adverse effect is manifested. As a result, there is a range of exposures (from zero to some finite value) that can be tolerated by the human body with essentially no expression of adverse effects. In developing a noncarcinogenic toxicity value, the approach is to identify the upper bound of this tolerance range (e.g., the maximum subthreshold level). Because there is variability within the human population, attempts are made to identify a subthreshold level that is protective of sensitive individuals in the population. For most chemicals, this level can only be estimated. Noncarcinogenic toxicity values (RfDs and RfCs) incorporate uncertainty factors that indicate the degree of extrapolation used to derive the estimated value. RfD and RfC summaries in IRIS also contain a statement expressing the overall confidence that the evaluators have in the RfD or RfC (high, medium, or low). RfDs and RfCs are considered to have uncertainty spanning an order of magnitude or more, and, therefore, RfDs and RfCs should not be viewed as a strict scientific demarcation between toxic and nontoxic levels.

The lack of a demonstrated threshold in dose-response relationships for carcinogens is generally interpreted by regulatory agencies to mean that a finite risk of cancer exists, even at very low doses of the carcinogen. EPA's SFs typically are derived using the 95UCL of the slope predicted by the linearized multistage model. The multistage model assumes that carcinogenesis results from a series of interactions between the carcinogenic chemical and deoxyribonucleic acid (DNA), with the rate of interactions

linearly related to dose. EPA recognizes that this method produces conservative risk estimates, and that there are other mathematical models.

Dermal toxicity values are not available in IRIS or HEAST. However, they are calculable using the dermal guidance from EPA (2004). The guidance provides methodology for adjusting oral toxicity values to be used in calculating risks for dermal exposure. Gastro-intestinal factors that modify the oral toxicity for the dermal pathway were included. The risk calculations in this document are based on the use of the gastro-intestinal factors for the soil pathways, and the PC and DA_{event} calculations for the water pathway as described above.

6.3.7   Uncertainties Related to Risk Characterization

The potential risk of adverse human health effects is characterized based on estimated potential exposures and estimated dose-response relationships. Two important additional sources of uncertainty are introduced in this phase of the HHRA: the evaluation of potential simultaneous exposure to multiple COCs and the combination of upper-bound exposure estimates with upper-bound toxicity estimates.

According to EPA guidance, after calculating the potential health risk from each COC, the total ILCR (and HI) posed by the exposure pathway is estimated by combining the estimated ILCR (and HQs) from each COC, organic or inorganic. Currently, additivity is assumed unless there is evidence indicating that the chemicals interact synergistically (a combined effect that is greater than a simple addition of potential individual effects) or antagonistically (a combined effect that is less than a simple addition of potential individual effects) with each other. For virtually all combinations of chemicals, there is little, if any, evidence of interaction. Therefore, additivity is assumed. Additivity can lead to either an underestimation or overestimation of risk, depending on the chemical combination

6.4   Summary of Sources of Uncertainty

There is uncertainty associated with the assumptions used to estimate potential risks from the site. While it is theoretically possible that this uncertainty leads to underestimates of potential risk, the use of numerous upper-bound and other health-protective assumptions more likely results in overestimates of potential risks. Any one individual's potential exposure and subsequent potential risk are influenced by all the exposure and toxicity parameters mentioned in this section and will vary on a case-by-case basis. Despite inevitable uncertainties associated with the steps used to estimate potential health risks, the use of numerous health-protective assumptions most likely leads to an overestimate of potential risks from exposure to environmental media at the site.

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7.   SUMMARY AND CONCLUSIONS

Since the Order's inception, CPCPRC has implemented the requirements of the Order and the AOC investigation work specifically addresses the requirement in Section VI of the Order for identifying newly discovered contamination, controlling exposure to that contamination and for notifying EPA and PREQB of that discovery.

During the course of the AOC investigation, 259 surface soil samples, 259 subsurface soil samples, 38 groundwater samples, three sediment samples and, three surface water samples were collected and analyzed for comprehensive list of 74 chemicals that could have been present at the Facility. These analytical data, along with the collection of groundwater in May/June 2012 and December 2012, were compared to conservative risk-based levels and a list of COPCs was developed.

The HHRA included in Section 6 of this AOC Investigation Report assessed the potential risk from the COPCs and the findings show that benzene is the risk driver for the resident under a hypothetical drinking water scenario. The construction worker would be at risk from benzene in groundwater and sulfolane in the combined soil during the course of construction. The industrial worker would not be at risk working at this site now or in the future based on the HHRA results. Similarly, the trespassers would not be at risk now or in future from exposure to soil, Effluent Channel sediments or Effluent Channel surface water.

The SLERA, also included in Section 6, evaluated potential ecological risks and some potential for excess risk was identified through this conservative screening. For soil, there were some chemicals exceeding conservative screening levels; however, soil is already targeted for potential corrective measures as a result of the human health risks. For the Effluent Channel surface water and sediment, potential ecological risk will be eliminated by the dewatering the channel, removing sediment and, backfilling this channel as part of decommissioning.

Based on the findings presented in this AOC Investigation Report, and EPA/PREQB review of the data presented in the July 2012 draft of this report, it is concluded that, with the exception of sulfolane, the nature and extent of contamination in the AOCs has been defined and this AOC Investigation reporting is complete. The response to comments on the AOC Investigation Report can be found in Appendix F.

To refine the nature and extent of sulfolane, CPCPRC has submitted a Supplemental RFI Work Plan (SRFI) for additional soil and groundwater characterization for sulfolane. The findings of this AOC Investigation Report, the findings of the approved July 1999 RFI, along with findings of the upcoming SRFI for sulfolane are intended to be synthesized toward the development and submittal of a CMS Work Plan for agency approval. A report outline for the SRFI can be found in Appendix G.

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Figures

Source | **Release Mechanism** | **Exposure Media** | **Exposure Route**

Exposure Media	Exposure Route	Trespasser Current/Future	Industrial Worker Current/Future	Resident Current/Future	Construction Worker Current/Future	Ecological Receptors Current/Future
Channel Surface Water	Ingestion	●	○	○	○	
	Dermal Contact	●	○	○	○	●
	Inhalation of Vapors	●	○	○	○	
Channel Sediment	Ingestion	●	○	○	○	
	Dermal Contact	●	○	○	○	●
	Inhalation of Vapors and Particulates - Outdoors	●	○	○	○	
Surface Soil	Ingestion	●	●	○	●	●
	Dermal Contact	●	●	○	●	
Air	Inhalation of Vapors and Particulates - Indoors	○	●	○	○	
	Inhalation of Vapors and Particulates - Outdoors	●	●	○	●	○
Subsurface Soil Combined Soil	Ingestion	○	○	○	●	○
	Dermal Contact	○	○	○	●	
Air	Inhalation of Vapors - Indoors	○	○	○	○	
	Inhalation of Vapors - Outdoors	○	○	○	●	○
	Indoor Vapor Intrusion	○	●	○		
Groundwater	Ingestion	○	○	●	○	○
	Dermal Contact	○	○	●	● *	
Air	Inhalation of Vapors - Indoors	○	○	●	○	
	Inhalation of Vapors - Outdoors	○	○	○	●	○
	Indoor Vapor Intrusion	○	●	●	○	

Source: Tank Basins

Release Mechanisms: Release/Runoff; Leaching; Fugitive Dust and vapors; Fugitive Dust; Volatilization

Notes:

● Complete pathway, will be quantitatively assessed in the HHRA and SLERA.
○ Incomplete pathway, will not be assessed in the HHRA or SLERA.
● * Complete pathway, if encountered within the excavation zone.

Conceptual Site Model - Chevron Phillips Chemical Puerto Rico Core Facility

Figure 6-1. Conceptual site model.

Tables

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Table 1-1. Modified Skinner List Chemicals.

Chemical	Group	Chemical	Group
Antimony	M	Di-n-butylphthalate	S
Arsenic	M	Di-n-octylphthalate	S
Barium	M	Fluoranthene	S
Beryllium	M	Fluorene	S
Cadmium	M	Hexachlorobenzene	S
Chromium	M	Hexachloroethane	S
Chromium, Hexavalent	M	Indeno(1,2,3-cd)pyrene	S
Cobalt	M	Naphthalene	S
Copper	M	Nitrobenzene	S
Cyanide	M	Pentachlorophenol	S
Lead	M	Phenol	S
Manganese	M	Pyrene	S
Mercury	M	Pyridine	S
Nickel	M	Sulfolane	S
Selenium	M	1,1,1-Trichloroethane	V
Silver	M	1,1-Dichloroethene	V
Vanadium	M	1,2-Dibromoethane (EDB)	V
Zinc	M	1,2-Dichlorobenzene	V
2,4,5-Trichlorophenol	S	1,2-Dichloroethane	V
2,4,6-Trichlorophenol	S	1,4-Dichlorobenzene	V
2,4-Dimethylphenol	S	1,4-Dioxane (p-Dioxane)	V
2,4-Dinitrotoluene	S	2-Butanone	V
2-Methylphenol (o-Cresol)	S	Acetone	V
3 & 4-Methylphenol	S	Benzene	V
3-Methylphenol (m-Cresol)	S	Carbon disulfide	V
4-Methylphenol (p-Cresol)	S	Carbon Tetrachloride	V
7,12-Dimethylbenz(a)anthracene	S	Chloroform	V
Acenaphthene	S	Ethylbenzene	V
Anthracene	S	Hexachlorobutadiene	V
Benzo(a)anthracene	S	m&p-Xylene	V
Benzo(a)pyrene	S	Methyl-tert-butyl ether	V
Benzo(b)fluoranthene	S	o-Xylene	V
bis(2-Ethylhexyl)phthalate	S	Styrene	V
Butylbenzylphthalate	S	Tetrachloroethene	V
Chlorobenzene	S	Toluene	V
Chrysene	S	Trichloroethene	V
Dibenz(a,h)anthracene	S	Vinyl Chloride	V
CAS No. = Chemical Abstract Service Registry Number. Group: V = volatile organic compound, S = semi-volatile organic compound, M = metal/inorganic			

Table 2-1. Identified areas of concern.

Tank Number	Tank Diameter	Stored Product
Tank 10	200 ft	Naphtha
Tank 20	200 ft	Naphtha
Tank 41	67 ft	process water
Tank 42	67 ft	process water
Tank 80	67 ft	mixed xylenes
Tank 100	119 ft	diesel range organic (C9+)
Tank 160	180 ft	blend stocks
Tank 170	173 ft	finished gasoline
Tank 220	200 ft	Cyclohexane
Tank 240	36 ft	benzene mix
Tank 330	100 ft	Cyclohexane
Tank 340	110 ft	Diesel
Tank 360	212 ft	Naphtha
Tank 401	35 ft	Paraxylene
Tank 403	35 ft	Paraxylene
Tank 540	20 ft*	Sulfolane
Tank 690	20 ft	Orthoxylene
Tank 700	20 ft	orthoxylene
Tank 710	150 ft	paraxylene
*Tank 540 is a 20 ft by 20 ft square area rather than a circular tank		

Table 4-1. Surface soil sample statistics.

Data_Group	Matrix	Analysis	Analyte	Number of Exceedances	Number of Detects	Number of Samples	Unit	Maximum Detected	Location of Maximum	Maximum Background	RBSL	Basis
Site	SS	Metals	Antimony	54	54	259	ug/Kg	2400	0010-14-SO-2		105	CW_SSL
Site	SS	Metals	Arsenic	259	259	259	ug/Kg	54000	0020-02-SO-2	6000	1.3	Res_SSL
Site	SS	Metals	Barium	259	259	259	ug/Kg	330000	0401-07-SO-2	110000	22329	CW_SSL
Site	SS	Metals	Beryllium		252	259	ug/Kg	310	0020-05-SO-2	170	428	CW_SSL
Site	SS	Metals	Cadmium	196	196	259	ug/Kg	4500	0360-18-SO-2		73	CW_SSL
Site	SS	Metals	Chromium		259	259	ug/Kg	150000	0010-01-SO-2	13000	464545454	CW_SS
Site	SS	Metals	Chromium, hexavalent	193	193	259	ug/Kg	9800	0080-11-SO-2	1200	1.3	CW_SSL
Site	SS	Metals	Cobalt	259	259	259	ug/Kg	32000	0710-06-SO-2	22000	212	Res_SSL
Site	SS	Metals	Copper	254	259	259	ug/Kg	340000	0710-06-SO-2	81000	21881	Res_SSL
Site	SS	Metals	Cyanide, Total	2	40	259	ug/Kg	6100	0020-04-SO-2		3144	Res_SSL
Site	SS	Metals	Lead	51	259	259	ug/Kg	210000	0700-12-SO-2	8700	13503	Res
Site	SS	Metals	Manganese	259	259	259	ug/Kg	8300000	0340-05-SO-2	1100000	141852	Res_SSL
Site	SS	Metals	Mercury	19	257	259	ug/Kg	690	0020-13-SO-2	38	42	CW_SSL
Site	SS	Metals	Nickel	50	259	259	ug/Kg	230000	0010-14-SO-2	6600	10096	CW_SSL
Site	SS	Metals	Selenium	92	92	259	ug/Kg	4000	0710-01-SO-2	1300	404	Res_SSL
Site	SS	Metals	Silver	54	54	259	ug/Kg	680	0340-05-SO-2	310	110	CW_SSL
Site	SS	Metals	Vanadium	231	259	259	ug/Kg	230000	0540-13-SO-2	140000	77717	Res_SSL
Site	SS	Metals	Zinc	2	259	259	ug/Kg	610000	0020-14-SO-2	66000	290744	Res_SSL
Site	SS	SVOC	2,4,5-Trichlorophenol			259	ug/Kg				15975	Res_SSL
Site	SS	SVOC	2,4,6-Trichlorophenol			259	ug/Kg				64	Res_SSL
Site	SS	SVOC	2,4-Dimethylphenol		16	259	ug/Kg	820	0401-08-SO-2		1403	Res_SSL
Site	SS	SVOC	2,4-Dinitrotoluene	1	1	259	ug/Kg	450	0360-11-SO-2		1.2	Res_SSL
Site	SS	SVOC	2-Methylphenol		13	259	ug/Kg	300	0360-07-SO-2		2344	Res_SSL
Site	SS	SVOC	3 & 4 Methylphenol		13	259	ug/Kg	430	0170-09-SO-2		2297	Res_SSL
Site	SS	SVOC	7,12-Dimethylbenz(a)anthracene			259	ug/Kg				0.10	Res_SSL
Site	SS	SVOC	Acenaphthene		2	259	ug/Kg	630	0540-06-SO-2		19973	Res_SSL
Site	SS	SVOC	Anthracene		1	259	ug/Kg	120	0540-06-SO-2		211312	Res_SSL
Site	SS	SVOC	Benzo(a)anthracene	3	3	259	ug/Kg	98	0540-06-SO-2		11	Res_SSL
Site	SS	SVOC	Benzo(a)pyrene	6	6	259	ug/Kg	180	0690-01-SO-2		2.4	Res_SSL
Site	SS	SVOC	Benzo(a)pyrene	6	6	259	ug/Kg	180	0710-09-SO-2		2.4	Res_SSL
Site	SS	SVOC	Benzo(b)fluoranthene	8	8	259	ug/Kg	270	0540-06-SO-2		41	Res_SSL
Site	SS	SVOC	Bis(2-ethylhexyl) phthalate	22	34	259	ug/Kg	7200	0690-01-SO-2		68	Res_SSL
Site	SS	SVOC	Butyl benzyl phthalate			259	ug/Kg				938	Res_SSL
Site	SS	SVOC	Chrysene		2	259	ug/Kg	300	0540-06-SO-2		1017	Res_SSL
Site	SS	SVOC	Dibenz(a,h)anthracene			259	ug/Kg				5.0	Res_SSL
Site	SS	SVOC	Di-n-butyl phthalate		10	259	ug/Kg	320	0540-03-SO-2		7408	Res_SSL
Site	SS	SVOC	Di-n-octyl phthalate			259	ug/Kg				430670	Res_SSL
Site	SS	SVOC	Fluoranthene		3	259	ug/Kg	710	0540-06-SO-2		45110	Res_SSL
Site	SS	SVOC	Fluorene		3	259	ug/Kg	5700	0540-06-SO-2		19824	Res_SSL

Table 4-1 (continued).

Data_Group	Matrix	Analysis	Analyte	Number of Exceedances	Number of Detects	Number of Samples	Unit	Maximum Detected	Location of Maximum	Maximum Background	RBSL	Basis
Site	SS	SVOC	Hexachlorobenzene			259	ug/Kg				0.25	Res_SSL
Site	SS	SVOC	Hexachloroethane			259	ug/Kg				4.9	Res_SSL
Site	SS	SVOC	Indeno(1,2,3-cd)pyrene	4	5	259	ug/Kg	100	0540-06-SO-2		40	Res_SSL
Site	SS	SVOC	Naphthalene	7	17	259	ug/Kg	4200	0170-06-SO-2		734	IW_SS
Site	SS	SVOC	Nitrobenzene			259	ug/Kg				72	Res_SSL
Site	SS	SVOC	Pentachlorophenol			259	ug/Kg				1.6	Res_SSL
Site	SS	SVOC	Phenol		20	259	ug/Kg	1400	0170-06-SO-2		9262	Res_SSL
Site	SS	SVOC	Pyrene		3	259	ug/Kg	590	0540-06-SO-2		47443	Res_SSL
Site	SS	SVOC	Pyridine			259	ug/Kg				14	Res_SSL
Site	SS	SVOC	Sulfolane	36	36	259	ug/Kg	17000000	0540-06-SO-2		3.2	Res_SSL
Site	SS	VOC	1,1,1-Trichloroethane			259	ug/Kg				5258	Res_SSL
Site	SS	VOC	1,1-Dichloroethene			259	ug/Kg				160	Res_SSL
Site	SS	VOC	1,2-Dichlorobenzene			259	ug/Kg				1124	Res_SSL
Site	SS	VOC	1,2-Dichloroethane			259	ug/Kg				0.09	Res_SSL
Site	SS	VOC	1,4-Dichlorobenzene			259	ug/Kg				1.7	Res_SSL
Site	SS	VOC	1,4-Dioxane			259	ug/Kg				0.07	Res_SSL
Site	SS	VOC	2-Butanone (MEK)		33	259	ug/Kg	29	0540-07-SO-2		1206	Res_SSL
Site	SS	VOC	Acetone	7	93	259	ug/Kg	41000	0042-04-SO-2		2576	Res_SSL
Site	SS	VOC	Benzene	79	79	259	ug/Kg	12000	0170-06-SO-2		0.66	Res_SSL
Site	SS	VOC	Carbon disulfide		8	259	ug/Kg	43	0540-08-SO-2		336	Res_SSL
Site	SS	VOC	Carbon tetrachloride			259	ug/Kg				0.29	Res_SSL
Site	SS	VOC	Chlorobenzene			259	ug/Kg				184	Res_SSL
Site	SS	VOC	Chloroform			259	ug/Kg				0.10	Res_SSL
Site	SS	VOC	Ethylbenzene	54	67	259	ug/Kg	710000	0080-13-SO-2		6.1	Res_SSL
Site	SS	VOC	Ethylene Dibromide			259	ug/Kg				0.004	Res_SSL
Site	SS	VOC	Hexachlorobutadiene			259	ug/Kg				1.0	Res_SSL
Site	SS	VOC	Methyl tert-butyl ether	6	19	259	ug/Kg	220	0041-04-SO-2		3.9	Res_SSL
Site	SS	VOC	m-Xylene & p-Xylene	47	129	259	ug/Kg	5700000	0080-13-SO-2		765	Res_SSL
Site	SS	VOC	o-Xylene	29	70	259	ug/Kg	790000	0170-03-SO-2		765	Res_SSL
Site	SS	VOC	Styrene	2	15	259	ug/Kg	24000	0170-03-SO-2		4970	Res_SSL
Site	SS	VOC	Tetrachloroethene			259	ug/Kg				12	Res_SSL
Site	SS	VOC	Toluene	17	64	259	ug/Kg	57000	0170-03-SO-2		2195	Res_SSL
Site	SS	VOC	Trichloroethene			259	ug/Kg				1.6	Res_SSL
Site	SS	VOC	Vinyl chloride			259	ug/Kg				0.04	Res_SSL

Data_Group:

BKG = Background

Media:

  GW = Direct-punch groundwater grab samples

  Upper = Shallow groundwater; Lower = deep groundwater

  SD = channel sediment

SB = subsurface soil

SS/SB = combined surface sol and subsurface soil

SS = surface soil

SW = channel surface water

Table 4-2. Subsurface soil sample statistics.

Data_Group	Matrix	Analysis	Analyte	Number of Exceedances	Number of Detects	Number of Samples	Unit	Maximum Detected	Location of Maximum	Maximum Background	RBSL	Basis
Site	SB	Metals	Antimony	47	47	259	ug/Kg	1900	0010-14-SO-5		105	CW_SSL
Site	SB	Metals	Arsenic	259	259	259	ug/Kg	44000	0710-06-SO-3	6000	1.3	Res_SSL
Site	SB	Metals	Barium	252	259	259	ug/Kg	200000	0220-09-SO-4	110000	22329	CW_SSL
Site	SB	Metals	Beryllium		246	259	ug/Kg	250	0042-04-SO-10	170	428	CW_SSL
Site	SB	Metals	Cadmium	194	194	259	ug/Kg	580	0100-02-SO-6		73	CW_SSL
Site	SB	Metals	Chromium		259	259	ug/Kg	88000	0710-06-SO-3	13000	464545454	CW_SS
Site	SB	Metals	Chromium, hexavalent	201	201	259	ug/Kg	7900	0080-14-SO-12	1200	1.3	CW_SSL
Site	SB	Metals	Cobalt	259	259	259	ug/Kg	58000	0710-06-SO-3	22000	212	Res_SSL
Site	SB	Metals	Copper	251	259	259	ug/Kg	710000	0710-06-SO-3	81000	21881	Res_SSL
Site	SB	Metals	Cyanide, Total	2	37	259	ug/Kg	6400	0020-03-SO-5		3144	Res_SSL
Site	SB	Metals	Lead	18	259	259	ug/Kg	46000	0403-13-SO-6	8700	13503	Res
Site	SB	Metals	Manganese	259	259	259	ug/Kg	3800000	0100-02-SO-6	1100000	141852	Res_SSL
Site	SB	Metals	Mercury	7	242	259	ug/Kg	250	0010-14-SO-5	38	42	CW_SSL
Site	SB	Metals	Nickel	14	259	259	ug/Kg	580000	0403-13-SO-6	6600	10096	CW_SSL
Site	SB	Metals	Selenium	98	98	259	ug/Kg	4000	0700-14-SO-11	1300	404	Res_SSL
Site	SB	Metals	Silver	39	39	259	ug/Kg	810	0710-06-SO-3	310	110	CW_SSL
Site	SB	Metals	Vanadium	235	259	259	ug/Kg	260000	0710-06-SO-3	140000	77717	Res_SSL
Site	SB	Metals	Zinc		259	259	ug/Kg	190000	0010-07-SO-6	66000	290744	Res_SSL
Site	SB	SVOC	2,4,5-Trichlorophenol			259	ug/Kg				15975	Res_SSL
Site	SB	SVOC	2,4,6-Trichlorophenol			259	ug/Kg				64	Res_SSL
Site	SB	SVOC	2,4-Dimethylphenol		26	259	ug/Kg	630	0401-02-SO-6		1403	Res_SSL
Site	SB	SVOC	2,4-Dinitrotoluene	2	2	259	ug/Kg	450	0401-08-SO-6		1.2	Res_SSL
Site	SB	SVOC	2-Methylphenol		13	259	ug/Kg	730	0170-04-SO-6		2344	Res_SSL
Site	SB	SVOC	3 & 4 Methylphenol		17	259	ug/Kg	940	0170-04-SO-6		2297	Res_SSL
Site	SB	SVOC	7,12-Dimethylbenz(a)anthracene	1	1	259	ug/Kg	63	0080-06-SO-6		0.10	Res_SSL
Site	SB	SVOC	Acenaphthene		5	259	ug/Kg	180	0170-04-SO-6		19973	Res_SSL
Site	SB	SVOC	Anthracene		3	259	ug/Kg	170	0700-13-SO-12		211312	Res_SSL
Site	SB	SVOC	Benzo(a)anthracene	3	3	259	ug/Kg	610	0170-04-SO-6		11	Res_SSL
Site	SB	SVOC	Benzo(a)pyrene	3	3	259	ug/Kg	400	0170-04-SO-6		2.4	Res_SSL
Site	SB	SVOC	Benzo(b)fluoranthene	6	6	259	ug/Kg	390	0170-04-SO-6		41	Res_SSL
Site	SB	SVOC	Bis(2-ethylhexyl) phthalate	28	40	259	ug/Kg	13000	0170-04-SO-6		68	Res_SSL
Site	SB	SVOC	Butyl benzyl phthalate			259	ug/Kg				938	Res_SSL
Site	SB	SVOC	Chrysene		6	259	ug/Kg	560	0700-13-SO-12		1017	Res_SSL
Site	SB	SVOC	Dibenz(a,h)anthracene			259	ug/Kg				5.0	Res_SSL
Site	SB	SVOC	Di-n-butyl phthalate		6	259	ug/Kg	250	0170-09-SO-6		7408	Res_SSL
Site	SB	SVOC	Di-n-octyl phthalate		1	259	ug/Kg	62	0160-15-SO-6		430670	Res_SSL
Site	SB	SVOC	Fluoranthene		6	259	ug/Kg	990	0170-04-SO-6		45110	Res_SSL
Site	SB	SVOC	Fluorene		12	259	ug/Kg	1300	0360-08-SO-6		19824	Res_SSL
Site	SB	SVOC	Hexachlorobenzene			259	ug/Kg				0.25	Res_SSL

Table 4-2. (continued).

Data_Group	Matrix	Analysis	Analyte	Number of Exceedances	Number of Detects	Number of Samples	Unit	Maximum Detected	Location of Maximum	Maximum Background	RBSL	Basis
Site	SB	SVOC	Hexachloroethane			259	ug/Kg				4.9	Res_SSL
Site	SB	SVOC	Indeno(1,2,3-cd)pyrene	4	4	259	ug/Kg	180	0170-04-SO-6		40	Res_SSL
Site	SB	SVOC	Naphthalene	6	19	259	ug/Kg	7400	0170-09-SO-6		734	IW_SS
Site	SB	SVOC	Nitrobenzene	1	1	259	ug/Kg	1500	0170-07-SO-6		72	Res_SSL
Site	SB	SVOC	Pentachlorophenol			259	ug/Kg				1.6	Res_SSL
Site	SB	SVOC	Phenol		40	259	ug/Kg	1100	0360-06-SO-7		9262	Res_SSL
Site	SB	SVOC	Pyrene		9	259	ug/Kg	770	0170-04-SO-6		47443	Res_SSL
Site	SB	SVOC	Pyridine			259	ug/Kg				14	Res_SSL
Site	SB	SVOC	Sulfolane	40	40	259	ug/Kg	370000	0540-09-SO-11		3.2	Res_SSL
Site	SB	VOC	1,1,1-Trichloroethane			259	ug/Kg				5258	Res_SSL
Site	SB	VOC	1,1-Dichloroethene			259	ug/Kg				160	Res_SSL
Site	SB	VOC	1,2-Dichlorobenzene			259	ug/Kg				1124	Res_SSL
Site	SB	VOC	1,2-Dichloroethane	2	2	259	ug/Kg	83	0042-07-SO-6		0.09	Res_SSL
Site	SB	VOC	1,4-Dichlorobenzene			259	ug/Kg				1.7	Res_SSL
Site	SB	VOC	1,4-Dioxane			259	ug/Kg				0.07	Res_SSL
Site	SB	VOC	2-Butanone (MEK)		52	259	ug/Kg	180	0042-06-SO-10		1206	Res_SSL
Site	SB	VOC	Acetone	8	130	259	ug/Kg	47000	0042-03-SO-6		2576	Res_SSL
Site	SB	VOC	Benzene	111	111	259	ug/Kg	170000	0360-06-SO-7		0.66	Res_SSL
Site	SB	VOC	Carbon disulfide		32	259	ug/Kg	52	0540-09-SO-11		336	Res_SSL
Site	SB	VOC	Carbon tetrachloride			259	ug/Kg				0.29	Res_SSL
Site	SB	VOC	Chlorobenzene		1	259	ug/Kg	140	0360-12-SO-4		184	Res_SSL
Site	SB	VOC	Chloroform			259	ug/Kg				0.10	Res_SSL
Site	SB	VOC	Ethylbenzene	95	132	259	ug/Kg	470000	0403-12-SO-6		6.1	Res_SSL
Site	SB	VOC	Ethylene Dibromide			259	ug/Kg				0.004	Res_SSL
Site	SB	VOC	Hexachlorobutadiene			259	ug/Kg				1.0	Res_SSL
Site	SB	VOC	Methyl tert-butyl ether	7	18	259	ug/Kg	260	0170-13-SO-10		3.9	Res_SSL
Site	SB	VOC	m-Xylene & p-Xylene	67	169	259	ug/Kg	3700000	0401-05-SO-6		765	Res_SSL
Site	SB	VOC	o-Xylene	32	117	259	ug/Kg	270000	0700-02-SO-6		765	Res_SSL
Site	SB	VOC	Styrene	2	19	259	ug/Kg	15000	0700-03-SO-10		4970	Res_SSL
Site	SB	VOC	Tetrachloroethene			259	ug/Kg				12	Res_SSL
Site	SB	VOC	Toluene	15	70	259	ug/Kg	260000	0540-13-SO-16		2195	Res_SSL
Site	SB	VOC	Trichloroethene			259	ug/Kg				1.6	Res_SSL
Site	SB	VOC	Vinyl chloride			259	ug/Kg				0.04	Res_SSL

Data_Group:

BKG = Background

Media:

GW = Direct-punch groundwater grab samples   SW = channel surface water

MW = Shallow groundwater; MWD = deep groundwater; MW/MWD = combined shallow and deep groundwater

SD = channel sediment   SS = surface soil; SB = subsurface soil; SS/SB = combined surface sol and subsurface soil

Table 4-3. Background comparison, AOC surface soil samples.

	Statistical Distribution and Comparison to Background AOC Surface Soil Samples									
	Statistical Distribution Testing Results								Wilcoxon-Mann-Whitney Test	
	Background				AOC Surface Soil Samples					
Constituent	Total Samples	Total Detects	Maximum Detected (µg/Kg)	Distribution Recommended by ProUCL	Total Samples	Total Detects	Maximum Detected (µg/Kg)	Distribution Recommended by ProUCL	p-value	Statistical Conclusion (p => 0.05)
Antimony	10	0	0	NA	259	55	2400	95% KM (t) UCL	0.501	Conclude Site <= Background
Arsenic	10	10	6000	Use 95% Student's-t UCL	259	259	54000	Use 95% Student's-t UCL	0.302	Conclude Site <= Background
Barium	10	10	110000	Use 95% Student's-t UCL	259	259	330000	Use 95% Student's-t UCL	0.294	Conclude Site <= Background
Beryllium	10	10	170	Use 95% Student's-t UCL	259	252	310	95% KM (BCA) UCL	0.501	Conclude Site <= Background
Cadmium	10	0	0	NA	259	196	4500	95% KM (BCA) UCL	2.96E-05	Conclude Site > Background
Chromium	10	10	13000	Use 95% Student's-t UCL	259	259	150000	Use 95% Chebyshev (Mean, Sd) UCL	0.0102	Conclude Site > Background
Chromium, hexavalent	10	10	1200	Use 95% Approximate Gamma UCL	259	187	9800	95% KM (Chebyshev) UCL	0.12	Conclude Site <= Background
Cobalt	10	10	22000	Use 95% Student's-t UCL	259	259	32000	Use 95% Student's-t UCL	0.397	Conclude Site <= Background
Copper	10	10	81000	Use 95% Student's-t UCL	259	259	340000	Use 95% Student's-t UCL	0.00814	Conclude Site > Background
Lead	10	10	8700	Use 95% Student's-t UCL	259	259	210000	Use 95% Chebyshev (Mean, Sd) UCL	0.779	Conclude Site <= Background
Manganese	10	10	1100000	Use 95% Approximate Gamma UCL	259	259	8300000	Use 95% Student's-t UCL	0.749	Conclude Site <= Background
Mercury	10	10	38	Use 95% Student's-t UCL	259	256	690	95% KM (BCA) UCL	0.99	Conclude Site <= Background
Nickel	10	10	6600	Use 95% Student's-t UCL	259	259	230000	Use 95% Chebyshev (Mean, Sd) UCL	5.28E-06	Conclude Site > Background
Selenium	10	10	1300	Use 95% Student's-t UCL	259	92	4000	95% KM (t) UCL	0.501	Conclude Site <= Background
Silver	10	10	310	Use 95% Student's-t UCL	259	54	680	95% KM (t) UCL	1	Conclude Site <= Background
Vanadium	10	10	140000	Use 95% Student's-t UCL	259	259	230000	Use 95% Student's-t UCL	0.924	Conclude Site <= Background
Zinc	10	10	66000	Use 95% Student's-t UCL	259	259	610000	Use 95% Student's-t UCL	8.75E-04	Conclude Site > Background

Shaded metals signify site concentrations statistically greater than the background concentrations.
The ProUCL two-sample comparison output is provided in Appendix B.

Table 4-4. Background comparison, AOC subsurface soil samples.

	Statistical Distribution and Comparison to Background AOC Subsurface Soil Samples									
	Statistical Distribution Testing Results								Wilcoxon-Mann-Whitney Test	
	Background				AOC Subsurface Soil Samples					
Constituent	Total Samples	Total Detects	Maximum Detected (µg/Kg)	Distribution Recommended by ProUCL	Total Samples	Total Detects	Maximum Detected (µg/Kg)	Distribution Recommended by ProUCL	p-value	Statistical Conclusion (p => 0.05)
Antimony	10	0	0	NA	259	47	1900	95% KM (t) UCL	0.501	Conclude Site <= Background
Arsenic	10	10	6000	Use 95% Student's-t UCL	259	259	44000	Use 95% Student's-t UCL	0.658	Conclude Site <= Background
Barium	10	10	110000	Use 95% Student's-t UCL	259	259	200000	Use 95% Student's-t UCL	0.684	Conclude Site <= Background
Beryllium	10	10	170	Use 95% Student's-t UCL	259	246	250	95% KM (BCA) UCL	0.501	Conclude Site <= Background
Cadmium	10	0	0	NA	259	194	580	95% KM (BCA) UCL	4.57E-05	Conclude Site > Background
Chromium	10	10	13000	Use 95% Student's-t UCL	259	259	88000	Use 95% Student's-t UCL	0.0411	Conclude Site > Background
Chromium, hexavalent	10	10	1200	Use 95% Approximate Gamma UCL	259	200	7900	95% KM (BCA) UCL	0.501	Conclude Site <= Background
Cobalt	10	10	22000	Use 95% Student's-t UCL	259	259	58000	Use 95% Student's-t UCL	0.462	Conclude Site <= Background
Copper	10	10	81000	Use 95% Student's-t UCL	259	259	710000	Use 95% Student's-t UCL	0.039	Conclude Site > Background
Lead	10	10	8700	Use 95% Student's-t UCL	259	259	46000	Use 95% Chebyshev (Mean, Sd) UCL	1	Conclude Site <= Background
Manganese	10	10	1100000	Use 95% Approximate Gamma UCL	259	259	3800000	Use 95% Student's-t UCL	0.924	Conclude Site <= Background
Mercury	10	10	38	Use 95% Student's-t UCL	259	242	250	95% KM (BCA) UCL	1	Conclude Site <= Background
Nickel	10	10	6600	Use 95% Student's-t UCL	259	259	580000	Use 95% Chebyshev (Mean, Sd) UCL	5.49E-03	Conclude Site > Background
Selenium	10	10	1300	Use 95% Student's-t UCL	259	98	4000	95% KM (t) UCL	1	Conclude Site <= Background
Silver	10	10	310	Use 95% Student's-t UCL	259	39	810	95% KM (t) UCL	1	Conclude Site <= Background
Vanadium	10	10	140000	Use 95% Student's-t UCL	259	259	260000	Use 95% Student's-t UCL	0.807	Conclude Site <= Background
Zinc	10	10	66000	Use 95% Student's-t UCL	259	259	190000	Use 95% Student's-t UCL	9.15E-02	Conclude Site <= Background

Shaded metals signify site concentrations statistically greater than the background concentrations.
The ProUCL two-sample comparison output is provided in Appendix B.

Table 4-5. Background comparison, AOC combined soil samples.

| | Statistical Distribution Testing Results | | | | | | | | | Wilcoxon-Mann-Whitney Test | |
| | Background | | | | AOC Combined Soil Samples | | | | | | |
Constituent	Total Samples	Total Detects	Maximum Detected (µg/Kg)	Distribution Recommended by ProUCL	Total Samples	Total Detects	Maximum Detected (µg/Kg)	Distribution Recommended by ProUCL	p-value	Statistical Conclusion (p => 0.05)
Antimony	10	0	0	NA	518	102	2400	95% KM (t) UCL	0.5	Conclude Site <= Background
Arsenic	10	10	6000	Use 95% Student's-t UCL	518	518	54000	Use 95% Student's-t UCL	0.477	Conclude Site <= Background
Barium	10	10	110000	Use 95% Student's-t UCL	518	518	330000	Use 95% Student's-t UCL	0.487	Conclude Site <= Background
Beryllium	10	10	170	Use 95% Student's-t UCL	518	498	310	95% KM (BCA) UCL	0.5	Conclude Site <= Background
Cadmium	10	0	0	NA	518	390	4500	95% KM (BCA) UCL	3.08E-05	Conclude Site > Background
Chromium	10	10	13000	Use 95% Student's-t UCL	518	518	150000	Use 95% Chebyshev (Mean, Sd) UCL	0.0202	Conclude Site > Background
Chromium, hexavalent	10	10	1200	Use 95% Approximate Gamma UCL	518	387	9800	95% KM (Chebyshev) UCL	0.5	Conclude Site <= Background
Cobalt	10	10	22000	Use 95% Student's-t UCL	518	518	58000	Use 95% Student's-t UCL	0.428	Conclude Site <= Background
Copper	10	10	81000	Use 95% Student's-t UCL	518	518	710000	Use 95% Student's-t UCL	0.0176	Conclude Site > Background
Lead	10	10	8700	Use 95% Student's-t UCL	518	518	210000	Use 95% Chebyshev (Mean, Sd) UCL	0.982	Conclude Site <= Background
Manganese	10	10	1100000	Use 95% Approximate Gamma UCL	518	518	8300000	Use 95% Student's-t UCL	0.856	Conclude Site <= Background
Mercury	10	10	38	Use 95% Student's-t UCL	518	498	690	95% KM (BCA) UCL	0.998	Conclude Site <= Background
Nickel	10	10	6600	Use 95% Student's-t UCL	518	518	580000	Use 95% Chebyshev (Mean, Sd) UCL	2.23E-04	Conclude Site > Background
Selenium	10	10	1300	Use 95% Student's-t UCL	518	190	4000	95% KM (t) UCL	0.5	Conclude Site <= Background
Silver	10	10	310	Use 95% Student's-t UCL	518	93	810	95% KM (t) UCL	1	Conclude Site <= Background
Vanadium	10	10	140000	Use 95% Student's-t UCL	518	518	260000	Use 95% Student's-t UCL	0.877	Conclude Site <= Background
Zinc	10	10	66000	Use 95% Student's-t UCL	518	518	610000	Use 95% Student's-t UCL	1.21E-02	Conclude Site > Background

Shaded metals signify site concentrations statistically greater than the background concentrations.
The ProUCL two-sample comparison output is provided in Appendix B.

Table 4-44. AOC direct-push groundwater sample statistics.

Data_Group	Matrix	Analysis	Analyte	Number of Exceedances	Number of Detects	Number of Samples	Unit	Maximum Detected	Location of Maximum	RBSL	Basis
Site	GW	Metals	Antimony	1	1	38	ug/L	11	0020-17-GW	2.3	CW_GW
Site	GW	Metals	Arsenic	34	34	38	ug/L	230	0360-14-GW	0.0446	Res_GW
Site	GW	Metals	Barium	25	38	38	ug/L	26000	0360-14-GW	542	CW_GW
Site	GW	Metals	Beryllium	10	10	38	ug/L	31	0360-14-GW	0.542	CW_GW
Site	GW	Metals	Cadmium	16	16	38	ug/L	40	0360-14-GW	0.9678	CW_GW
Site	GW	Metals	Chromium	2	37	38	ug/L	2400	0360-14-GW	755	CW_GW
Site	GW	Metals	Chromium, hexavalent	4	4	38	ug/L	11	0160-15-GW	0.0677	CW_GW
Site	GW	Metals	Cobalt	33	37	38	ug/L	3000	0360-14-GW	4.7	Res_GW
Site	GW	Metals	Copper	16	38	38	ug/L	19000	0360-14-GW	622	Res_GW
Site	GW	Metals	Cyanide, Total		3	38	ug/L	5.6	0710-10-GW	311	Res_GW
Site	GW	Metals	Lead	21	38	38	ug/L	1700	0360-14-GW	15	MCL
Site	GW	Metals	Manganese	30	38	38	ug/L	140000	0360-14-GW	2176	Res_GW
Site	GW	Metals	Mercury	1	11	38	ug/L	0.94	0403-10-GW	0.813	CW_GW
Site	GW	Metals	Nickel	4	32	38	ug/L	1100	0360-14-GW	155	CW_GW
Site	GW	Metals	Selenium	1	15	38	ug/L	110	0360-14-GW	78	Res_GW
Site	GW	Metals	Silver		6	38	ug/L	4.8	0020-14-GW	13	CW_GW
Site	GW	Metals	Vanadium	28	38	38	ug/L	22000	0360-14-GW	78	Res_GW
Site	GW	Metals	Zinc	1	37	38	ug/L	13000	0360-14-GW	4674	Res_GW
Site	GW	SVOC	2,4,5-Trichlorophenol			38	ug/L			887	Res_GW
Site	GW	SVOC	2,4,6-Trichlorophenol			38	ug/L			3.5	Res_GW
Site	GW	SVOC	2,4-Dimethylphenol		4	38	ug/L	50	0360-14-GW	274	Res_GW
Site	GW	SVOC	2,4-Dinitrotoluene	2	2	38	ug/L	220	0080-10-GW	0.2048	Res_GW
Site	GW	SVOC	2-Methylphenol			38	ug/L			717	Res_GW
Site	GW	SVOC	3 & 4 Methylphenol		10	38	ug/L	42	0360-17-GW	718	Res_GW
Site	GW	SVOC	7,12-Dimethylbenz(a)anthracene			38	ug/L			0.00002	Res_GW
Site	GW	SVOC	Acenaphthene		6	38	ug/L	4.2	0170-02-GW	396	Res_GW
Site	GW	SVOC	Anthracene		3	38	ug/L	0.76	0010-14-GW	1287	Res_GW
Site	GW	SVOC	Benzo(a)anthracene			38	ug/L			0.006	Res_GW
Site	GW	SVOC	Benzo(a)pyrene	1	1	38	ug/L	0.13	0010-17-GW	0.0004	Res_GW
Site	GW	SVOC	Benzo(b)fluoranthene			38	ug/L			0.0068	Res_GW
Site	GW	SVOC	Bis(2-ethylhexyl) phthalate			38	ug/L			0.0568	Res_GW
Site	GW	SVOC	Butyl benzyl phthalate			38	ug/L			13	Res_GW
Site	GW	SVOC	Chrysene			38	ug/L			0.5618	Res_GW
Site	GW	SVOC	Dibenz(a,h)anthracene			38	ug/L			0.0003	Res_GW
Site	GW	SVOC	Di-n-butyl phthalate			38	ug/L			628	Res_GW
Site	GW	SVOC	Di-n-octyl phthalate			38	ug/L			305	Res_GW
Site	GW	SVOC	Fluoranthene		3	38	ug/L	0.49	0010-14-GW	81	Res_GW
Site	GW	SVOC	Fluorene		14	38	ug/L	34	0710-10-GW	216	Res_GW
Site	GW	SVOC	Hexachlorobenzene			38	ug/L			0.004	Res_GW

Table 4-44 (continued).

Data_Group	Matrix	Analysis	Analyte	Number of Exceedances	Number of Detects	Number of Samples	Unit	Maximum Detected	Location of Maximum	RBSL	Basis
Site	GW	SVOC	Hexachloroethane			38	ug/L			2.2	Res_GW
Site	GW	SVOC	Indeno(1,2,3-cd)pyrene			38	ug/L			0.0021	Res_GW
Site	GW	SVOC	Naphthalene	3	25	38	ug/L	420	0710-10-GW	192	Res_GW
Site	GW	SVOC	Nitrobenzene			38	ug/L			29	Res_GW
Site	GW	SVOC	Pentachlorophenol			38	ug/L			0.0324	Res_GW
Site	GW	SVOC	Phenol		9	38	ug/L	79	0690-10-GW	4475	Res_GW
Site	GW	SVOC	Pyrene		3	38	ug/L	0.39	0010-17-GW	87	Res_GW
Site	GW	SVOC	Pyridine			38	ug/L			15	Res_GW
Site	GW	SVOC	Sulfolane	26	35	38	ug/L	100000	0540-08-GW	16	Res_GW
Site	GW	VOC	1,1,1-Trichloroethane			38	ug/L			7492	Res_GW
Site	GW	VOC	1,1-Dichloroethene			38	ug/L			260	Res_GW
Site	GW	VOC	1,2-Dichlorobenzene			38	ug/L			278	Res_GW
Site	GW	VOC	1,2-Dichloroethane			38	ug/L			0.1757	Res_GW
Site	GW	VOC	1,4-Dichlorobenzene			38	ug/L			0.5143	Res_GW
Site	GW	VOC	1,4-Dioxane			38	ug/L			0.3626	Res_GW
Site	GW	VOC	2-Butanone (MEK)			38	ug/L			4915	Res_GW
Site	GW	VOC	Acetone		5	38	ug/L	120	0010-17-GW	11515	Res_GW
Site	GW	VOC	Benzene	26	26	38	ug/L	230000	0360-17-GW	0.4505	Res_GW
Site	GW	VOC	Carbon disulfide		1	38	ug/L	2.9	0010-14-GW	715	Res_GW
Site	GW	VOC	Carbon tetrachloride			38	ug/L			0.4349	Res_GW
Site	GW	VOC	Chlorobenzene		1	38	ug/L	9.2	0010-17-GW	72	Res_GW
Site	GW	VOC	Chloroform			38	ug/L			0.2335	Res_GW
Site	GW	VOC	Ethylbenzene	29	29	38	ug/L	17000	0401-08-GW	1.5	Res_GW
Site	GW	VOC	Ethylene Dibromide			38	ug/L			0.0077	Res_GW
Site	GW	VOC	Hexachlorobutadiene			38	ug/L			0.1285	Res_GW
Site	GW	VOC	Methyl tert-butyl ether	1	2	38	ug/L	39	0360-14-GW	14	Res_GW
Site	GW	VOC	m-Xylene & p-Xylene	21	33	38	ug/L	63000	0700-08-GW	189	Res_GW
Site	GW	VOC	o-Xylene	14	26	38	ug/L	17000	0700-08-GW	189	Res_GW
Site	GW	VOC	Styrene		7	38	ug/L	560	0700-08-GW	1064	Res_GW
Site	GW	VOC	Tetrachloroethene			38	ug/L			11	Res_GW
Site	GW	VOC	Toluene	6	20	38	ug/L	28000	0330-08-GW	856	Res_GW
Site	GW	VOC	Trichloroethene			38	ug/L			2.3	Res_GW
Site	GW	VOC	Vinyl chloride			38	ug/L			0.0816	Res_GW

Data_Group:

BKG = Background

Media:

GW = Direct-punch groundwater grab samples

MW = Upper alluvial groundwater; MWD = lower alluvial groundwater; MW/MWD = combined upper nad lower alluvial groundwater

SD = channel sediment

SW = channel surface water   SS = surface soil; SB = subsurface soil; SS/SB = combined surface sol and subsurface soil

Table 4-64. Upper Alluvial Aquifer groundwater sample statistics.

Data_Group	Matrix	Analysis	Analyte	Number of Exceedances	Number of Detects	Number of Samples	Unit	Maximum Detected	Location of Maximum	RBSL	Basis
Site	Upper	Metals	Antimony			55	ug/L			2.3	CW_GW
Site	Upper	Metals	Arsenic	27	27	55	ug/L	26	TW-1R	0.0446	Res_GW
Site	Upper	Metals	Barium	11	55	55	ug/L	1300	MW-48	542	CW_GW
Site	Upper	Metals	Beryllium			55	ug/L			0.542	CW_GW
Site	Upper	Metals	Cadmium	2	2	55	ug/L	2.1	MW-113	0.9678	CW_GW
Site	Upper	Metals	Chromium	1	8	55	ug/L	1800	MW-147	755	CW_GW
Site	Upper	Metals	Chromium, hexavalent	17	17	55	ug/L	24	RW-G	0.0677	CW_GW
Site	Upper	Metals	Cobalt	5	8	55	ug/L	19	MW-42	4.7	Res_GW
Site	Upper	Metals	Copper		22	55	ug/L	86	MW-42	622	Res_GW
Site	Upper	Metals	Cyanide, Total		1	55	ug/L	3.2	MW-158	311	Res_GW
Site	Upper	Metals	Lead	1	14	55	ug/L	53	MW-113	15	MCL
Site	Upper	Metals	Manganese	16	55	55	ug/L	15000	MW-48	2176	Res_GW
Site	Upper	Metals	Mercury		8	55	ug/L	0.22	RW-D	0.813	CW_GW
Site	Upper	Metals	Mercury		8	55	ug/L	0.22	RW-E	0.813	CW_GW
Site	Upper	Metals	Nickel	1	14	55	ug/L	450	MW-147	155	CW_GW
Site	Upper	Metals	Selenium		2	55	ug/L	7.2	MW-49	78	Res_GW
Site	Upper	Metals	Silver			55	ug/L			13	CW_GW
Site	Upper	Metals	Vanadium	1	18	55	ug/L	120	MW-42	78	Res_GW
Site	Upper	Metals	Zinc		12	55	ug/L	740	MW-113	4674	Res_GW
Site	Upper	SVOC	2,4,5-Trichlorophenol			55	ug/L			887	Res_GW
Site	Upper	SVOC	2,4,6-Trichlorophenol			55	ug/L			3.5	Res_GW
Site	Upper	SVOC	2,4-Dimethylphenol		4	55	ug/L	17	RW-A	274	Res_GW
Site	Upper	SVOC	2,4-Dinitrotoluene			55	ug/L			0.2048	Res_GW
Site	Upper	SVOC	2-Methylphenol		2	55	ug/L	6.1	RW-K	717	Res_GW
Site	Upper	SVOC	3 & 4 Methylphenol		7	55	ug/L	14	RW-A	718	Res_GW
Site	Upper	SVOC	7,12-Dimethylbenz(a)anthracene			55	ug/L			0.00002	Res_GW
Site	Upper	SVOC	Acenaphthene		15	55	ug/L	3.9	MW-107	396	Res_GW
Site	Upper	SVOC	Anthracene		9	55	ug/L	8.5	MW-14	1287	Res_GW
Site	Upper	SVOC	Benzo(a)anthracene	1	1	55	ug/L	0.27	PZ-1R	0.006	Res_GW
Site	Upper	SVOC	Benzo(a)pyrene	1	1	55	ug/L	0.15	PZ-1R	0.0004	Res_GW
Site	Upper	SVOC	Benzo(b)fluoranthene	1	1	55	ug/L	0.3	PZ-1R	0.0068	Res_GW
Site	Upper	SVOC	Bis(2-ethylhexyl) phthalate	1	1	55	ug/L	3.5	MW-43	0.0568	Res_GW
Site	Upper	SVOC	Butyl benzyl phthalate			55	ug/L			13	Res_GW
Site	Upper	SVOC	Chrysene		1	55	ug/L	0.31	PZ-1R	0.5618	Res_GW
Site	Upper	SVOC	Dibenz(a,h)anthracene			55	ug/L			0.0003	Res_GW
Site	Upper	SVOC	Di-n-butyl phthalate			55	ug/L			628	Res_GW
Site	Upper	SVOC	Di-n-octyl phthalate			55	ug/L			305	Res_GW
Site	Upper	SVOC	Fluoranthene		2	55	ug/L	0.84	MW-107	81	Res_GW
Site	Upper	SVOC	Fluorene		26	55	ug/L	83	MW-107	216	Res_GW

Table 4-64. (continued).

Data_Group	Matrix	Analysis	Analyte	Number of Exceedances	Number of Detects	Number of Samples	Unit	Maximum Detected	Location of Maximum	RBSL	Basis
Site	Upper	SVOC	Hexachlorobenzene			55	ug/L			0.004	Res_GW
Site	Upper	SVOC	Hexachloroethane			55	ug/L			2.2	Res_GW
Site	Upper	SVOC	Indeno(1,2,3-cd)pyrene	1	1	55	ug/L	0.27	PZ-1R	0.0021	Res_GW
Site	Upper	SVOC	Naphthalene	2	33	84	ug/L	250	TW-1R	192	Res_GW
Site	Upper	SVOC	Nitrobenzene		1	55	ug/L	8.4	TW-1R	29	Res_GW
Site	Upper	SVOC	Pentachlorophenol			55	ug/L			0.0324	Res_GW
Site	Upper	SVOC	Phenol		6	55	ug/L	120	NEW WELL-1	4475	Res_GW
Site	Upper	SVOC	Pyrene		2	55	ug/L	0.63	MW-14	87	Res_GW
Site	Upper	SVOC	Pyridine			55	ug/L			15	Res_GW
Site	Upper	SVOC	Sulfolane	39	64	84	ug/L	14000	MW-113	16	Res_GW
Site	Upper	VOC	1,1,1-Trichloroethane			55	ug/L			7492	Res_GW
Site	Upper	VOC	1,1-Dichloroethene			55	ug/L			260	Res_GW
Site	Upper	VOC	1,2-Dichlorobenzene		2	55	ug/L	1.1	RW-I	278	Res_GW
Site	Upper	VOC	1,2-Dichloroethane			55	ug/L			0.1757	Res_GW
Site	Upper	VOC	1,4-Dichlorobenzene	3	3	55	ug/L	1.9	TW-2	0.5143	Res_GW
Site	Upper	VOC	1,4-Dioxane			55	ug/L			0.3626	Res_GW
Site	Upper	VOC	2-Butanone (MEK)			55	ug/L			4915	Res_GW
Site	Upper	VOC	Acetone		1	55	ug/L	46	MW-135	11515	Res_GW
Site	Upper	VOC	Benzene	30	31	93	ug/L	190000	NEW WELL-1	0.4505	Res_GW
Site	Upper	VOC	Carbon disulfide			55	ug/L			715	Res_GW
Site	Upper	VOC	Carbon tetrachloride			55	ug/L			0.4349	Res_GW
Site	Upper	VOC	Chlorobenzene		8	55	ug/L	18	RW-I	72	Res_GW
Site	Upper	VOC	Chloroform			55	ug/L			0.2335	Res_GW
Site	Upper	VOC	Ethylbenzene	20	27	93	ug/L	14000	MW-116	1.5	Res_GW
Site	Upper	VOC	Ethylene Dibromide			55	ug/L			0.0077	Res_GW
Site	Upper	VOC	Hexachlorobutadiene			55	ug/L			0.1285	Res_GW
Site	Upper	VOC	Methyl tert-butyl ether	2	28	84	ug/L	20	MW-28	14	Res_GW
Site	Upper	VOC	m-Xylene & p-Xylene	11	28	93	ug/L	39000	MW-116	189	Res_GW
Site	Upper	VOC	o-Xylene	7	18	93	ug/L	29000	MW-116	189	Res_GW
Site	Upper	VOC	Styrene			55	ug/L			1064	Res_GW
Site	Upper	VOC	Tetrachloroethene			55	ug/L			11	Res_GW
Site	Upper	VOC	Toluene	4	13	93	ug/L	4500	RW-A	856	Res_GW
Site	Upper	VOC	Trichloroethene			55	ug/L			2.3	Res_GW
Site	Upper	VOC	Vinyl chloride			55	ug/L			0.0816	Res_GW

Data_Group:

  BKG = Background

Media:

  GW = Direct-punch groundwater grab samples   SW = channel surface water

  Upper = upper alluvial groundwater; Lower = lower alluvial groundwater

  SD = channel sediment   SS = surface soil; SB = subsurface soil; SS/SB = combined surface sol and subsurface soil

Table 4-65. Lower Alluvial Aquifer groundwater sample statistics.

Data_Group	Matrix	Analysis	Analyte	Number of Exceedances	Number of Detects	Number of Samples	Unit	Maximum Detected	Location of Maximum	RBSL	Basis
Site	Lower	Metals	Antimony			23	ug/L			2.3	CW_GW
Site	Lower	Metals	Arsenic	8	8	23	ug/L	180	MW-129D	0.0446	Res_GW
Site	Lower	Metals	Barium		23	23	ug/L	160	MW-129D	542	CW_GW
Site	Lower	Metals	Barium		23	23	ug/L	160	MW-136D	542	CW_GW
Site	Lower	Metals	Beryllium			23	ug/L			0.542	CW_GW
Site	Lower	Metals	Cadmium	1	1	23	ug/L	1	DMW-2	0.9678	CW_GW
Site	Lower	Metals	Chromium		9	23	ug/L	640	MW-133D	755	CW_GW
Site	Lower	Metals	Chromium, hexavalent			23	ug/L			0.0677	CW_GW
Site	Lower	Metals	Cobalt	2	3	23	ug/L	7.1	MW-46D	4.7	Res_GW
Site	Lower	Metals	Copper		13	23	ug/L	28	MW-46D	622	Res_GW
Site	Lower	Metals	Cyanide, Total			23	ug/L			311	Res_GW
Site	Lower	Metals	Lead		14	23	ug/L	4.6	MW-46D	15	MCL
Site	Lower	Metals	Manganese	4	23	23	ug/L	3700	MW-117D	2176	Res_GW
Site	Lower	Metals	Mercury	1	4	23	ug/L	1.5	MW-133D	0.813	CW_GW
Site	Lower	Metals	Nickel		5	23	ug/L	120	MW-133D	155	CW_GW
Site	Lower	Metals	Selenium		1	23	ug/L	6.1	MW-133D	78	Res_GW
Site	Lower	Metals	Silver			23	ug/L			13	CW_GW
Site	Lower	Metals	Vanadium		17	23	ug/L	58	MW-46D	78	Res_GW
Site	Lower	Metals	Zinc		6	23	ug/L	25	MW-46D	4674	Res_GW
Site	Lower	SVOC	2,4,5-Trichlorophenol			23	ug/L			887	Res_GW
Site	Lower	SVOC	2,4,6-Trichlorophenol			23	ug/L			3.5	Res_GW
Site	Lower	SVOC	2,4-Dimethylphenol			23	ug/L			274	Res_GW
Site	Lower	SVOC	2,4-Dinitrotoluene			23	ug/L			0.2048	Res_GW
Site	Lower	SVOC	2-Methylphenol			23	ug/L			717	Res_GW
Site	Lower	SVOC	3 & 4 Methylphenol			23	ug/L			718	Res_GW
Site	Lower	SVOC	7,12-Dimethylbenz(a)anthracene			23	ug/L			0.00002	Res_GW
Site	Lower	SVOC	Acenaphthene		1	23	ug/L	0.21	MW-136D	396	Res_GW
Site	Lower	SVOC	Anthracene			23	ug/L			1287	Res_GW
Site	Lower	SVOC	Benzo(a)anthracene			23	ug/L			0.006	Res_GW
Site	Lower	SVOC	Benzo(a)pyrene			23	ug/L			0.0004	Res_GW
Site	Lower	SVOC	Benzo(b)fluoranthene			23	ug/L			0.0068	Res_GW
Site	Lower	SVOC	Bis(2-ethylhexyl) phthalate	2	2	23	ug/L	10	MW-123D	0.0568	Res_GW
Site	Lower	SVOC	Butyl benzyl phthalate			23	ug/L			13	Res_GW
Site	Lower	SVOC	Chrysene			23	ug/L			0.5618	Res_GW
Site	Lower	SVOC	Dibenz(a,h)anthracene			23	ug/L			0.0003	Res_GW
Site	Lower	SVOC	Di-n-butyl phthalate			23	ug/L			628	Res_GW
Site	Lower	SVOC	Di-n-octyl phthalate			23	ug/L			305	Res_GW
Site	Lower	SVOC	Fluoranthene			23	ug/L			81	Res_GW
Site	Lower	SVOC	Fluorene		1	23	ug/L	4.1	MW-136D	216	Res_GW

Table 4-65. (continued).

Data_Group	Matrix	Analysis	Analyte	Number of Exceedances	Number of Detects	Number of Samples	Unit	Maximum Detected	Location of Maximum	RBSL	Basis
Site	Lower	SVOC	Hexachlorobenzene			23	ug/L			0.004	Res_GW
Site	Lower	SVOC	Hexachloroethane			23	ug/L			2.2	Res_GW
Site	Lower	SVOC	Indeno(1,2,3-cd)pyrene			23	ug/L			0.0021	Res_GW
Site	Lower	SVOC	Naphthalene		4	39	ug/L	29	MW-21D	192	Res_GW
Site	Lower	SVOC	Nitrobenzene			23	ug/L			29	Res_GW
Site	Lower	SVOC	Pentachlorophenol			23	ug/L			0.0324	Res_GW
Site	Lower	SVOC	Phenol			23	ug/L			4475	Res_GW
Site	Lower	SVOC	Pyrene			23	ug/L			87	Res_GW
Site	Lower	SVOC	Pyridine			23	ug/L			15	Res_GW
Site	Lower	SVOC	Sulfolane	23	26	39	ug/L	2800	MW-46D	16	Res_GW
Site	Lower	VOC	1,1,1-Trichloroethane			23	ug/L			7492	Res_GW
Site	Lower	VOC	1,1-Dichloroethene			23	ug/L			260	Res_GW
Site	Lower	VOC	1,2-Dichlorobenzene			23	ug/L			278	Res_GW
Site	Lower	VOC	1,2-Dichloroethane			23	ug/L			0.1757	Res_GW
Site	Lower	VOC	1,4-Dichlorobenzene			23	ug/L			0.5143	Res_GW
Site	Lower	VOC	1,4-Dioxane			23	ug/L			0.3626	Res_GW
Site	Lower	VOC	2-Butanone (MEK)			23	ug/L			4915	Res_GW
Site	Lower	VOC	Acetone			23	ug/L			11515	Res_GW
Site	Lower	VOC	Benzene	11	11	39	ug/L	21	MW-159D	0.4505	Res_GW
Site	Lower	VOC	Carbon disulfide			23	ug/L			715	Res_GW
Site	Lower	VOC	Carbon tetrachloride			23	ug/L			0.4349	Res_GW
Site	Lower	VOC	Chlorobenzene		1	23	ug/L	2	MW-136D	72	Res_GW
Site	Lower	VOC	Chloroform	1	1	23	ug/L	10	MW-133D	0.2335	Res_GW
Site	Lower	VOC	Ethylbenzene		1	39	ug/L	1.1	MW-136D	1.5	Res_GW
Site	Lower	VOC	Ethylene Dibromide			23	ug/L			0.0077	Res_GW
Site	Lower	VOC	Hexachlorobutadiene			23	ug/L			0.1285	Res_GW
Site	Lower	VOC	Methyl tert-butyl ether	1	11	39	ug/L	27	MW-159D	14	Res_GW
Site	Lower	VOC	m-Xylene & p-Xylene		1	39	ug/L	2.5	MW-136D	189	Res_GW
Site	Lower	VOC	o-Xylene			39	ug/L			189	Res_GW
Site	Lower	VOC	Styrene			23	ug/L			1064	Res_GW
Site	Lower	VOC	Tetrachloroethene		2	23	ug/L	1.5	MW-106D	11	Res_GW
Site	Lower	VOC	Toluene			39	ug/L			856	Res_GW
Site	Lower	VOC	Trichloroethene			23	ug/L			2.3	Res_GW
Site	Lower	VOC	Vinyl chloride			23	ug/L			0.0816	Res_GW

Data_Group:

  BKG = Background

Media:

  GW = Direct-punch groundwater grab samples   SW = channel surface water

  Upper = Shallow groundwater; Lower = deep groundwater   SS = surface soil; SB = subsurface soil; SS/SB = combined surface soil and subsurface soil

  SD = channel sediment

Table 4-68. Effluent channel surface water sample statistics.

Data_Group	Matrix	Analysis	Analyte	Number of Exceedances	Number of Detects	Number of Samples	Unit	Maximum Detected	Location of Maximum	RBSL	Basis
Site	SW	Metals	Antimony			3	ug/L			2.8	Tres_SW
Site	SW	Metals	Arsenic			3	ug/L			0.1812	Tres_SW
Site	SW	Metals	Barium		3	3	ug/L	98	DITCH-1	657	Tres_SW
Site	SW	Metals	Beryllium			3	ug/L			0.657	Tres_SW
Site	SW	Metals	Cadmium			3	ug/L			1.2	Tres_SW
Site	SW	Metals	Chromium		1	3	ug/L	4.1	DITCH-2	915	Tres_SW
Site	SW	Metals	Chromium, hexavalent			3	ug/L			0.2728	Tres_SW
Site	SW	Metals	Cobalt			3	ug/L			35	Tres_SW
Site	SW	Metals	Copper			3	ug/L			1864	Tres_SW
Site	SW	Metals	Cyanide, Total			3	ug/L			1233	Tres_SW
Site	SW	Metals	Lead			3	ug/L			15	MCL
Site	SW	Metals	Manganese		3	3	ug/L	340	DITCH-3	6523	Tres_SW
Site	SW	Metals	Mercury			3	ug/L			0.985	Tres_SW
Site	SW	Metals	Nickel		3	3	ug/L	18	DITCH-2	187	Tres_SW
Site	SW	Metals	Selenium			3	ug/L			233	Tres_SW
Site	SW	Metals	Silver			3	ug/L			16	Tres_SW
Site	SW	Metals	Vanadium		3	3	ug/L	35	DITCH-2	233	Tres_SW
Site	SW	Metals	Zinc		1	3	ug/L	12	DITCH-2	23188	Tres_SW
Site	SW	SVOC	2,4,5-Trichlorophenol			3	ug/L			52819	Tres_SW
Site	SW	SVOC	2,4,6-Trichlorophenol			3	ug/L			292	Tres_SW
Site	SW	SVOC	2,4-Dimethylphenol			3	ug/L			39918	Tres_SW
Site	SW	SVOC	2,4-Dinitrotoluene			3	ug/L			66	Tres_SW
Site	SW	SVOC	2-Methylphenol			3	ug/L			130271	Tres_SW
Site	SW	SVOC	3 & 4 Methylphenol			3	ug/L			131510	Tres_SW
Site	SW	SVOC	7,12-Dimethylbenz(a)anthracene			3	ug/L			0.0008	Tres_SW
Site	SW	SVOC	Acenaphthene			3	ug/L			17839	Tres_SW
Site	SW	SVOC	Anthracene			3	ug/L			48431	Tres_SW
Site	SW	SVOC	Benzo(a)anthracene			3	ug/L			0.2453	Tres_SW
Site	SW	SVOC	Benzo(a)pyrene			3	ug/L			0.0163	Tres_SW
Site	SW	SVOC	Benzo(b)fluoranthene			3	ug/L			0.278	Tres_SW
Site	SW	SVOC	Bis(2-ethylhexyl) phthalate			3	ug/L			2.2	Tres_SW
Site	SW	SVOC	Butyl benzyl phthalate			3	ug/L			760	Tres_SW
Site	SW	SVOC	Chrysene			3	ug/L			23	Tres_SW
Site	SW	SVOC	Dibenz(a,h)anthracene			3	ug/L			0.0103	Tres_SW
Site	SW	SVOC	Di-n-butyl phthalate			3	ug/L			28110	Tres_SW
Site	SW	SVOC	Di-n-octyl phthalate			3	ug/L			96162	Tres_SW
Site	SW	SVOC	Fluoranthene			3	ug/L			2589	Tres_SW
Site	SW	SVOC	Fluorene			3	ug/L			8920	Tres_SW
Site	SW	SVOC	Hexachlorobenzene			3	ug/L			0.168	Tres_SW

Table 4-68. (continued).

Data_Group	Matrix	Analysis	Analyte	Number of Exceedances	Number of Detects	Number of Samples	Unit	Maximum Detected	Location of Maximum	RBSL	Basis
Site	SW	SVOC	Hexachloroethane			3	ug/L			152	Tres_SW
Site	SW	SVOC	Indeno(1,2,3-cd)pyrene			3	ug/L			0.0804	Tres_SW
Site	SW	SVOC	Naphthalene			6	ug/L			11974	Tres_SW
Site	SW	SVOC	Nitrobenzene			3	ug/L			6127	Tres_SW
Site	SW	SVOC	Pentachlorophenol			3	ug/L			1.5	Tres_SW
Site	SW	SVOC	Phenol			3	ug/L			1082431	Tres_SW
Site	SW	SVOC	Pyrene			3	ug/L			2960	Tres_SW
Site	SW	SVOC	Pyridine			3	ug/L			5154	Tres_SW
Site	SW	SVOC	Sulfolane	1		6	ug/L	0.94	DITCH-1	6436	Tres_SW
Site	SW	VOC	1,1,1-Trichloroethane			3	ug/L			388921	Tres_SW
Site	SW	VOC	1,1-Dichloroethene			3	ug/L			14947	Tres_SW
Site	SW	VOC	1,2-Dichlorobenzene			3	ug/L			13055	Tres_SW
Site	SW	VOC	1,2-Dichloroethane			3	ug/L			18	Tres_SW
Site	SW	VOC	1,4-Dichlorobenzene			3	ug/L			43	Tres_SW
Site	SW	VOC	1,4-Dioxane			3	ug/L			56	Tres_SW
Site	SW	VOC	2-Butanone (MEK)			3	ug/L			387593	Tres_SW
Site	SW	VOC	Acetone			3	ug/L			1811018	Tres_SW
Site	SW	VOC	Benzene			6	ug/L			49	Tres_SW
Site	SW	VOC	Carbon disulfide			3	ug/L			47799	Tres_SW
Site	SW	VOC	Carbon tetrachloride			3	ug/L			48	Tres_SW
Site	SW	VOC	Chlorobenzene			3	ug/L			3583	Tres_SW
Site	SW	VOC	Chloroform			3	ug/L			21	Tres_SW
Site	SW	VOC	Ethylbenzene			6	ug/L			126	Tres_SW
Site	SW	VOC	Ethylene Dibromide			3	ug/L			0.7876	Tres_SW
Site	SW	VOC	Hexachlorobutadiene			3	ug/L			8.1	Tres_SW
Site	SW	VOC	Methyl tert-butyl ether			6	ug/L			1742	Tres_SW
Site	SW	VOC	m-Xylene & p-Xylene			6	ug/L			8205	Tres_SW
Site	SW	VOC	o-Xylene			6	ug/L			8205	Tres_SW
Site	SW	VOC	Styrene			3	ug/L			56656	Tres_SW
Site	SW	VOC	Tetrachloroethene			3	ug/L			964	Tres_SW
Site	SW	VOC	Toluene			6	ug/L			65941	Tres_SW
Site	SW	VOC	Trichloroethene			3	ug/L			224	Tres_SW
Site	SW	VOC	Vinyl chloride			3	ug/L			18	Tres_SW

Data_Group:

  BKG = Background

Media:

  GW = Direct-punch groundwater grab samples   SS = surface soil; SB = subsurface soil; SS/SB = combined surface sol and subsurface soil

  Upper = Shallow groundwater; Lower = deep groundwater

  SD = channel sediment

  SW = channel surface water

Table 4-70. Effluent channel sediment sample statistics.

Data_Group	Matrix	Analysis	Analyte	Number of Exceedances	Number of Detects	Number of Samples	Unit	Maximum Detected	Location of Maximum	Maximum Background	RBSL	Basis
Site	SD	Metals	Antimony			3	ug/Kg				5256000	Tres_SD
Site	SD	Metals	Arsenic		3	3	ug/Kg	3100	CHANNEL-3	6000	22603	Tres_SD
Site	SD	Metals	Barium		3	3	ug/Kg	180000	CHANNEL-1	110000	2365816413	Tres_SD
Site	SD	Metals	Beryllium		3	3	ug/Kg	210	CHANNEL-1	170	25571530	Tres_SD
Site	SD	Metals	Cadmium		3	3	ug/Kg	410	CHANNEL-2		4877772	Tres_SD
Site	SD	Metals	Chromium		3	3	ug/Kg	67000	CHANNEL-2	13000	19710000000	Tres_SD
Site	SD	Metals	Chromium, hexavalent		3	3	ug/Kg	910	CHANNEL-3	1200	146482	Tres_SD
Site	SD	Metals	Cobalt		3	3	ug/Kg	21000	CHANNEL-2	22000	3888139	Tres_SD
Site	SD	Metals	Copper		3	3	ug/Kg	79000	CHANNEL-1	81000	525600000	Tres_SD
Site	SD	Metals	Cyanide, Total			3	ug/Kg				262800000	Tres_SD
Site	SD	Metals	Lead		3	3	ug/Kg	21000	CHANNEL-2	8700	400000	Res_SSL
Site	SD	Metals	Manganese		3	3	ug/Kg	1300000	CHANNEL-1	1100000	1035955892	Tres_SD
Site	SD	Metals	Manganese		3	3	ug/Kg	1300000	CHANNEL-3	1100000	1035955892	Tres_SD
Site	SD	Metals	Mercury		3	3	ug/Kg	73	CHANNEL-2	38	4057	Tres_SD
Site	SD	Metals	Nickel		3	3	ug/Kg	55000	CHANNEL-2	6600	247558431	Tres_SD
Site	SD	Metals	Selenium			3	ug/Kg			1300	65695450	Tres_SD
Site	SD	Metals	Silver			3	ug/Kg			310	65700000	Tres_SD
Site	SD	Metals	Vanadium		3	3	ug/Kg	150000	CHANNEL-1	140000	65700000	Tres_SD
Site	SD	Metals	Vanadium		3	3	ug/Kg	150000	CHANNEL-2	140000	65700000	Tres_SD
Site	SD	Metals	Zinc		3	3	ug/Kg	160000	CHANNEL-2	66000	3942000000	Tres_SD
Site	SD	SVOC	2,4,5-Trichlorophenol			3	ug/Kg				252692308	Tres_SD
Site	SD	SVOC	2,4,6-Trichlorophenol			3	ug/Kg				641325	Tres_SD
Site	SD	SVOC	2,4-Dimethylphenol			3	ug/Kg				50538462	Tres_SD
Site	SD	SVOC	2,4-Dinitrotoluene			3	ug/Kg				31568	Tres_SD
Site	SD	SVOC	2-Methylphenol			3	ug/Kg				101418395	Tres_SD
Site	SD	SVOC	3 & 4 Methylphenol			3	ug/Kg				113337089	Tres_SD
Site	SD	SVOC	7,12-Dimethylbenz(a)anthracene			3	ug/Kg				47	Tres_SD
Site	SD	SVOC	Acenaphthene			3	ug/Kg				122043344	Tres_SD
Site	SD	SVOC	Anthracene			3	ug/Kg				610216718	Tres_SD
Site	SD	SVOC	Benzo(a)anthracene			3	ug/Kg				16128	Tres_SD
Site	SD	SVOC	Benzo(a)pyrene			3	ug/Kg				1621	Tres_SD
Site	SD	SVOC	Benzo(b)fluoranthene			3	ug/Kg				16000	Tres_SD
Site	SD	SVOC	Bis(2-ethylhexyl) phthalate			3	ug/Kg				1052370	Tres_SD
Site	SD	SVOC	Butyl benzyl phthalate			3	ug/Kg				7758097	Tres_SD
Site	SD	SVOC	Chrysene			3	ug/Kg				1280244	Tres_SD
Site	SD	SVOC	Dibenz(a,h)anthracene			3	ug/Kg				1624	Tres_SD
Site	SD	SVOC	Di-n-butyl phthalate			3	ug/Kg				252692308	Tres_SD
Site	SD	SVOC	Di-n-octyl phthalate			3	ug/Kg				48567713	Tres_SD
Site	SD	SVOC	Fluoranthene			3	ug/Kg				81362229	Tres_SD

Table 4-70. (continued).

Data_Group	Matrix	Analysis	Analyte	Number of Exceedances	Number of Detects	Number of Samples	Unit	Maximum Detected	Location of Maximum	Maximum Background	RBSL	Basis
Site	SD	SVOC	Fluorene			3	ug/Kg				81362229	Tres_SD
Site	SD	SVOC	Hexachlorobenzene			3	ug/Kg				4737	Tres_SD
Site	SD	SVOC	Hexachloroethane			3	ug/Kg				361498	Tres_SD
Site	SD	SVOC	Indeno(1,2,3-cd)pyrene			3	ug/Kg				16233	Tres_SD
Site	SD	SVOC	Naphthalene			6	ug/Kg				40002	Tres_SD
Site	SD	SVOC	Nitrobenzene			3	ug/Kg				26805	Tres_SD
Site	SD	SVOC	Pentachlorophenol			3	ug/Kg				16605	Tres_SD
Site	SD	SVOC	Phenol			3	ug/Kg				127887348	Tres_SD
Site	SD	SVOC	Pyrene			3	ug/Kg				61021672	Tres_SD
Site	SD	SVOC	Pyridine			3	ug/Kg				13140000	Tres_SD
Site	SD	SVOC	Sulfolane	1		6	ug/Kg	130	CHANNEL-2		1397852	Tres_SD
Site	SD	VOC	1,1,1-Trichloroethane			3	ug/Kg				46100820	Tres_SD
Site	SD	VOC	1,1-Dichloroethene			3	ug/Kg				1193911	Tres_SD
Site	SD	VOC	1,2-Dichlorobenzene			3	ug/Kg				12086279	Tres_SD
Site	SD	VOC	1,2-Dichloroethane			3	ug/Kg				3649	Tres_SD
Site	SD	VOC	1,4-Dichlorobenzene			3	ug/Kg				28593	Tres_SD
Site	SD	VOC	1,4-Dioxane			3	ug/Kg				53205	Tres_SD
Site	SD	VOC	2-Butanone (MEK)			3	ug/Kg				385362346	Tres_SD
Site	SD	VOC	Acetone			3	ug/Kg				1427855223	Tres_SD
Site	SD	VOC	Benzene			6	ug/Kg				8473	Tres_SD
Site	SD	VOC	Carbon disulfide			3	ug/Kg				3476283	Tres_SD
Site	SD	VOC	Carbon tetrachloride			3	ug/Kg				8319	Tres_SD
Site	SD	VOC	Chlorobenzene			3	ug/Kg				1299933	Tres_SD
Site	SD	VOC	Chloroform			3	ug/Kg				2816	Tres_SD
Site	SD	VOC	Ethylbenzene			6	ug/Kg				52145	Tres_SD
Site	SD	VOC	Ethylene Dibromide			3	ug/Kg				370	Tres_SD
Site	SD	VOC	Hexachlorobutadiene			3	ug/Kg				56054	Tres_SD
Site	SD	VOC	Methyl tert-butyl ether			6	ug/Kg				434642	Tres_SD
Site	SD	VOC	m-Xylene & p-Xylene			6	ug/Kg				2542674	Tres_SD
Site	SD	VOC	o-Xylene			6	ug/Kg				2542674	Tres_SD
Site	SD	VOC	Styrene			3	ug/Kg				54747823	Tres_SD
Site	SD	VOC	Tetrachloroethene			3	ug/Kg				237391	Tres_SD
Site	SD	VOC	Toluene			6	ug/Kg				76970269	Tres_SD
Site	SD	VOC	Trichloroethene			3	ug/Kg				39571	Tres_SD
Site	SD	VOC	Vinyl chloride			3	ug/Kg				5457	Tres_SD

BKG = Background

Media:

GW = Direct-punch groundwater grab samples

Upper = Shallow groundwater; Lower = deep groundwater

SD = channel sediment

SW = channel surface water

SS = surface soil; SB = subsurface soil; SS/SB = combined surface sol and subsurface soil

Table 4-71. Effluent channel sediment results and criteria comparison (on CD).

Table 4-72. Chemicals of potential concern.

Analyte	Surface Soil	Subsurface Soil	AOC Groundwater	Upper Alluvial Groundwater	Lower Alluvial Groundwater
Antimony	X	X	X		
Arsenic	X	X	X	X	X
Barium	X	X	X	X	
Beryllium			X		
Cadmium	X	X	X	X	X
Chromium			X	X	
Chromium, hexavalent	X	X	X	X	
Cobalt	X	X	X	X	X
Copper	X	X	X		
Cyanide, Total	X	X			
Lead	X	X	X	X	
Manganese	X	X	X	X	X
Mercury	X	X	X		X
Nickel	X	X	X	X	
Selenium	X	X	X		
Silver	X	X			
Vanadium	X	X	X	X	
Zinc	X		X		
2,4-Dinitrotoluene	X	X	X		
7,12-Dimethylbenz(a)anthracene		X			
Benzo(a)anthracene	X	X		X	
Benzo(a)pyrene	X	X	X	X	
Benzo(b)fluoranthene	X	X		X	
Bis(2-ethylhexyl) phthalate	X	X		X	X
Indeno(1,2,3-cd)pyrene	X	X		X	
Naphthalene	X	X	X	X	
Nitrobenzene		X			
Sulfolane	X	X	X	X	X
1,2-Dichloroethane		X			
1,4-Dichlorobenzene				X	
Acetone	X	X			
Benzene	X	X	X	X	X
Chloroform					X
Ethylbenzene	X	X	X	X	
Methyl tert-butyl ether	X	X	X	X	X
m-Xylene & p-Xylene	X	X	X	X	
o-Xylene	X	X	X	X	
Styrene	X	X			
Toluene	X	X	X	X	

Table 6-1. Intake parameters used in calculation of site-specific risk-based screening levels.

Parameter	Receptor			
Common Parameters	**Resident**	**Construction Worker**	**Industrial Worker**	**Trespasser (teenager)**
EF_r (exposure frequency) day/yr	350	250	250	50
ED_r (exposure duration) yr	30	1	25	12
ED_c (exposure duration - Resident child) yr	6	NA	NA	NA
ED_a (exposure duration - Resident adult) yr	24	NA	NA	NA
ATc - (carcinogenic attenuation time) yr	70	70	70	70
ATn (noncarcinogenic attenuation time) yr	NA	1	25	12
ATn (noncarcinogenic attenuation time - resident child) yr	6	NA	NA	NA
ATn (noncarcinogenic attenuation time - resident adult yr	24	NA	NA	NA
BW_a (body weight - adult) kg	70	70	70	45
BW_c (body weight - child) kg	15	NA	NA	NA
Soil/Sediment parameters				
IRS_a (soil intake rate - adult) mg/day	NA	300	100	NA
IRS_a (soil intake rate - trespasser) mg/day	NA	NA	NA	75
IRS_a (sediment intake rate - trespasser) mg/day	NA	NA	NA	25
IRS_c (soil intake rate - child) mg/day	NA	NA	NA	NA
SA_a (skin surface area - adult) cm^2/day	NA	3,300	3,300	3,500
SA_c (skin surface area - child) cm^2/day	NA	NA	NA	NA
AF_a (skin adherence factor - adult) mg/cm^2	NA	0.3	0.2	0.3
AF_c (skin adherence factor - child) mg/cm^2	NA	NA	NA	NA
IFS_{adj} (age-adjusted soil ingestion factor) mg-yr/kg-day	NA	NA	NA	NA
DFS_{adj} (age-adjusted soil dermal factor) mg-yr/kg-day	NA	NA	NA	NA
VF (Volatilization factor) M^3/Kg	NA	Chemical-specific	Chemical-specific	Chemical-specific
PEF (particulate emission factor) M^3/Kg	NA	8.14E+06	1.08E+09	1.08E+09
ABS (dermal absorption factor) unitless	NA	Chemical-specific	Chemical-specific	Chemical-specific
Water parameters				
EV_c (shower - water contact events) events/day	1	1	NA	1
IRW (water intake rate) L/day	NA	NA	NA	0.05
IRW_a (water intake rate - adult) L/day	2	NA	NA	NA
IRW_c (water intake rate - child) L/day	1	NA	NA	NA
K (volatilization factor of Andelman) L/m^3	0.5	0.5		0.5
SA_a (skin surface area - adult) cm^2	18,000	3,300	NA	3,500
SA_c (skin surface area - child) cm^2	6,600	NA	NA	NA
ET_c (showering exposure time - child) hr/event	1	NA	NA	NA
ETa (showering/contact exposure time - adult) hr/event	0.58	8	NA	2
IFW_{adj} (adjusted intake factor) L-yr/kg-day	1.086	NA	NA	NA
DFW_{adj} (adjusted dermal factor) cm^2-yr-hr/kg-day	6,240	NA	NA	NA
Inhalation Parameters				
ETa (air inhalation exposure time) hrs/24hours	24/24	8/24	8/24	4/24

Table 6-2. Exposure point concentrations.

Analyte	Unit	Maximum Detected	EPC	EPC Basis
Upper Alluvial Aquifer				
1,2-Dichlorobenzene	ug/L	1.1	0.943	95UCL
1,4-Dichlorobenzene	ug/L	1.9	1.527	95UCL
2,4-Dimethylphenol	ug/L	17	5.911	95UCL
2-Methylphenol	ug/L	6.1	4.039	95UCL
3 & 4 Methylphenol	ug/L	14	1.618	95UCL
Acenaphthene	ug/L	3.9	0.547	95UCL
Acetone	ug/L	46	46	Max
Anthracene	ug/L	8.5	0.742	95UCL
Arsenic	ug/L	26	9.764	95UCL
Barium	ug/L	1300	395.2	95UCL
Benzene	ug/L	190000	16289	95UCL
Benzo(a)anthracene	ug/L	0.27	0.27	Max
Benzo(a)pyrene	ug/L	0.15	0.15	Max
Benzo(b)fluoranthene	ug/L	0.3	0.3	Max
Bis(2-ethylhexyl) phthalate	ug/L	3.5	3.5	Max
Cadmium	ug/L	2.1	2.1	Max
Chlorobenzene	ug/L	18	3.539	95UCL
Chromium	ug/L	1800	380.6	95UCL
Chromium, hexavalent	ug/L	24	8.701	95UCL
Chrysene	ug/L	0.31	0.31	Max
Cobalt	ug/L	19	5.167	95UCL
Copper	ug/L	86	9.22	95UCL
Cyanide, Total	ug/L	3.2	3.2	Max
Ethylbenzene	ug/L	14000	1232	95UCL
Fluoranthene	ug/L	0.84	0.54	95UCL
Fluorene	ug/L	83	7.228	95UCL
Indeno(1,2,3-cd)pyrene	ug/L	0.27	0.27	Max
Lead	ug/L	53	4.811	95UCL
Manganese	ug/L	15000	2455	95UCL
Mercury	ug/L	0.22	0.0933	95UCL
Mercury	ug/L	0.22	0.0933	95UCL
Methyl tert-butyl ether	ug/L	20	2.549	95UCL
m-Xylene & p-Xylene	ug/L	39000	3782	95UCL
Naphthalene	ug/L	250	25.13	95UCL
Nickel	ug/L	450	33.13	95UCL
Nitrobenzene	ug/L	8.4	8.4	Max
o-Xylene	ug/L	29000	988.8	95UCL
Phenol	ug/L	120	21.95	95UCL
Pyrene	ug/L	0.63	0.621	95UCL
Selenium	ug/L	7.2	4.57	95UCL
Sulfolane	ug/L	14000	1382	95UCL
Toluene	ug/L	4500	215.4	95UCL
Vanadium	ug/L	120	12.94	95UCL

Table 6-2. (continued).

Analyte	Unit	Maximum Detected	EPC	EPC Basis
Upper Alluvial Aquifer				
Zinc	ug/L	740	57.36	95UCL
Combined Upper Alluvial and Lower Alluvial Aquifers				
1,2-Dichlorobenzene	ug/L	1.1	0.938	95UCL
1,4-Dichlorobenzene	ug/L	1.9	1.518	95UCL
2,4-Dimethylphenol	ug/L	17	5.716	95UCL
2-Methylphenol	ug/L	6.1	4.001	95UCL
3 & 4 Methylphenol	ug/L	14	1.272	95UCL
Acenaphthene	ug/L	3.9	0.446	95UCL
Acetone	ug/L	46	46	Max
Anthracene	ug/L	8.5	0.637	95UCL
Arsenic	ug/L	180	14.51	95UCL
Barium	ug/L	1300	311.8	95UCL
Benzene	ug/L	190000	11469	95UCL
Benzo(a)anthracene	ug/L	0.27	0.27	Max
Benzo(a)pyrene	ug/L	0.15	0.15	Max
Benzo(b)fluoranthene	ug/L	0.3	0.3	Max
Bis(2-ethylhexyl) phthalate	ug/L	10	3.482	95UCL
Cadmium	ug/L	2.1	1.05	95UCL
Chlorobenzene	ug/L	18	2.902	95UCL
Chloroform	ug/L	10	10	Max
Chromium	ug/L	1800	143.9	95UCL
Chromium, hexavalent	ug/L	24	8.064	95UCL
Chrysene	ug/L	0.31	0.31	Max
Cobalt	ug/L	19	4.805	95UCL
Copper	ug/L	86	7.91	95UCL
Cyanide, Total	ug/L	3.2	3.2	Max
Ethylbenzene	ug/L	14000	870.4	95UCL
Fluoranthene	ug/L	0.84	0.535	95UCL
Fluorene	ug/L	83	5.24	95UCL
Indeno(1,2,3-cd)pyrene	ug/L	0.27	0.27	Max
Lead	ug/L	53	4.108	95UCL
Manganese	ug/L	15000	2056	95UCL
Mercury	ug/L	1.5	0.135	95UCL
Methyl tert-butyl ether	ug/L	27	2.76	95UCL
m-Xylene & p-Xylene	ug/L	39000	2676	95UCL
Naphthalene	ug/L	250	17.52	95UCL
Nickel	ug/L	450	26.47	95UCL
Nitrobenzene	ug/L	8.4	8.4	Max
o-Xylene	ug/L	29000	697	95UCL
Phenol	ug/L	120	19.03	95UCL
Pyrene	ug/L	0.63	0.62	95UCL
Selenium	ug/L	7.2	4.542	95UCL
Sulfolane	ug/L	14000	1112	95UCL
Tetrachloroethene	ug/L	1.5	1.31	95UCL

Table 6-2. (continued).

Analyte	Unit	Maximum Detected	EPC	EPC Basis
Combined Upper Alluvial and Lower Alluvial Aquifers				
Toluene	ug/L	4500	152.3	95UCL
Vanadium	ug/L	120	12.45	95UCL
Zinc	ug/L	740	42.34	95UCL
Effluent Channel Surface Water				
Barium	ug/L	98	98	Max
Chromium	ug/L	4.1	4.1	Max
Manganese	ug/L	340	340	Max
Nickel	ug/L	18	18	Max
Sulfolane	ug/L	0.94	0.94	Max
Vanadium	ug/L	35	35	Max
Zinc	ug/L	12	12	Max
Effluent Channel Sediment				
Arsenic	ug/Kg	3100	3100	Max
Barium	ug/Kg	180000	180000	Max
Beryllium	ug/Kg	210	210	Max
Cadmium	ug/Kg	410	410	Max
Chromium	ug/Kg	67000	67000	Max
Chromium, hexavalent	ug/Kg	910	910	Max
Cobalt	ug/Kg	21000	21000	Max
Copper	ug/Kg	79000	79000	Max
Lead	ug/Kg	21000	21000	Max
Manganese	ug/Kg	1300000	1300000	Max
Manganese	ug/Kg	1300000	1300000	Max
Mercury	ug/Kg	73	73	Max
Nickel	ug/Kg	55000	55000	Max
Sulfolane	ug/Kg	130	130	Max
Vanadium	ug/Kg	150000	150000	Max
Vanadium	ug/Kg	150000	150000	Max
Zinc	ug/Kg	160000	160000	Max
Surface Soil				
2,4-Dimethylphenol	ug/Kg	820	50.13	95UCL
2,4-Dinitrotoluene	ug/Kg	450	450	Max
2-Butanone (MEK)	ug/Kg	29	6.372	95UCL
2-Methylphenol	ug/Kg	300	45.38	95UCL
3 & 4 Methylphenol	ug/Kg	430	61.94	95UCL
Acenaphthene	ug/Kg	630	58.51	95UCL
Acetone	ug/Kg	41000	1944	95UCL
Anthracene	ug/Kg	120	120	Max
Antimony	ug/Kg	2400	1170	95UCL
Arsenic	ug/Kg	54000	4217	95UCL
Barium	ug/Kg	330000	106553	95UCL
Benzene	ug/Kg	12000	917.5	95UCL
Benzo(a)anthracene	ug/Kg	98	44.91	95UCL
Benzo(a)pyrene	ug/Kg	180	43.07	95UCL

Table 6-2. (continued).

Analyte	Unit	Maximum Detected	EPC	EPC Basis
Surface Soil				
Benzo(a)pyrene	ug/Kg	180	43.07	95UCL
Benzo(b)fluoranthene	ug/Kg	270	44.73	95UCL
Beryllium	ug/Kg	310	166.9	95UCL
Bis(2-ethylhexyl) phthalate	ug/Kg	7200	322.7	95UCL
Cadmium	ug/Kg	4500	331.3	95UCL
Carbon disulfide	ug/Kg	43	2.076	95UCL
Chromium	ug/Kg	150000	17582	95UCL
Chromium, hexavalent	ug/Kg	9800	2109	95UCL
Chrysene	ug/Kg	300	300	Max
Cobalt	ug/Kg	32000	20453	95UCL
Copper	ug/Kg	340000	81754	95UCL
Cyanide, Total	ug/Kg	6100	242	95UCL
Di-n-butyl phthalate	ug/Kg	320	53.79	95UCL
Ethylbenzene	ug/Kg	710000	28343	95UCL
Fluoranthene	ug/Kg	710	64.77	95UCL
Fluorene	ug/Kg	5700	110.6	95UCL
Indeno(1,2,3-cd)pyrene	ug/Kg	100	39.21	95UCL
Lead	ug/Kg	210000	19367	95UCL
Manganese	ug/Kg	8300000	1028164	95UCL
Mercury	ug/Kg	690	36.71	95UCL
Methyl tert-butyl ether	ug/Kg	220	5.003	95UCL
m-Xylene & p-Xylene	ug/Kg	5700000	169942	95UCL
Naphthalene	ug/Kg	4200	194.8	95UCL
Nickel	ug/Kg	230000	18829	95UCL
o-Xylene	ug/Kg	790000	30331	95UCL
Phenol	ug/Kg	1400	79.98	95UCL
Pyrene	ug/Kg	590	65.13	95UCL
Selenium	ug/Kg	4000	607.7	95UCL
Silver	ug/Kg	680	225.8	95UCL
Styrene	ug/Kg	24000	936.5	95UCL
Sulfolane	ug/Kg	17000000	493114	95UCL
Toluene	ug/Kg	57000	3571	95UCL
Vanadium	ug/Kg	230000	122740	95UCL
Zinc	ug/Kg	610000	85932	95UCL
Combined Surface Soil and Subsurface Soil				
1,2-Dichloroethane	ug/Kg	83	4.742	95UCL
2,4-Dimethylphenol	ug/Kg	820	52.62	95UCL
2,4-Dinitrotoluene	ug/Kg	450	440.1	95UCL
2-Butanone (MEK)	ug/Kg	180	7.973	95UCL
2-Methylphenol	ug/Kg	730	47.53	95UCL
3 & 4 Methylphenol	ug/Kg	940	62.19	95UCL
7,12-Dimethylbenz(a)anthracene	ug/Kg	63	63	Max
Acenaphthene	ug/Kg	630	40.16	95UCL
Acetone	ug/Kg	47000	1521	95UCL

Table 6-2. (continued).

Analyte	Unit	Maximum Detected	EPC	EPC Basis
Combined Surface Soil and Subsurface Soil				
Anthracene	ug/Kg	170	37.4	95UCL
Antimony	ug/Kg	2400	1159	95UCL
Arsenic	ug/Kg	54000	3774	95UCL
Barium	ug/Kg	330000	101098	95UCL
Benzene	ug/Kg	170000	2995	95UCL
Benzo(a)anthracene	ug/Kg	610	48.41	95UCL
Benzo(a)pyrene	ug/Kg	400	43.16	95UCL
Benzo(b)fluoranthene	ug/Kg	390	44.81	95UCL
Beryllium	ug/Kg	310	161.7	95UCL
Bis(2-ethylhexyl) phthalate	ug/Kg	13000	345	95UCL
Cadmium	ug/Kg	4500	290.6	95UCL
Carbon disulfide	ug/Kg	52	2.254	95UCL
Chlorobenzene	ug/Kg	140	140	Max
Chromium	ug/Kg	150000	15382	95UCL
Chromium, hexavalent	ug/Kg	9800	1887	95UCL
Chrysene	ug/Kg	560	47.53	95UCL
Cobalt	ug/Kg	58000	20122	95UCL
Copper	ug/Kg	710000	82480	95UCL
Cyanide, Total	ug/Kg	6400	223	95UCL
Di-n-butyl phthalate	ug/Kg	320	42.76	95UCL
Di-n-octyl phthalate	ug/Kg	62	62	Max
Ethylbenzene	ug/Kg	710000	19216	95UCL
Fluoranthene	ug/Kg	990	48.56	95UCL
Fluorene	ug/Kg	5700	84.27	95UCL
Indeno(1,2,3-cd)pyrene	ug/Kg	180	39.2	95UCL
Lead	ug/Kg	210000	12244	95UCL
Manganese	ug/Kg	8300000	974348	95UCL
Mercury	ug/Kg	690	28.71	95UCL
Methyl tert-butyl ether	ug/Kg	260	6.89	95UCL
m-Xylene & p-Xylene	ug/Kg	5700000	120504	95UCL
Naphthalene	ug/Kg	7400	249	95UCL
Nickel	ug/Kg	580000	17261	95UCL
Nitrobenzene	ug/Kg	1500	1500	Max
o-Xylene	ug/Kg	790000	17124	95UCL
Phenol	ug/Kg	1400	78.87	95UCL
Pyrene	ug/Kg	770	45.03	95UCL
Selenium	ug/Kg	4000	589.8	95UCL
Silver	ug/Kg	810	211.8	95UCL
Styrene	ug/Kg	24000	569	95UCL
Sulfolane	ug/Kg	17000000	247127	95UCL
Toluene	ug/Kg	260000	5184	95UCL
Vanadium	ug/Kg	260000	123355	95UCL
Zinc	ug/Kg	610000	75541	95UCL

Table 6-3. Summary of cumulative risks for resident.

Media	Pathway	HI	% HI	ILCR	% ILCR
Combined Upper Alluvial and Lower Alluvial Groundwater	**Ingestion**	**3.E+02**	53%	**1.E-02**	37%
	Dermal	**3.E+01**	6%	**2.E-03**	8%
	Inhalation	**2.E+02**	41%	**2.E-02**	56%
	Total	**5.E+02**	100%	**3.E-02**	100%

Table 6-6. Summary of cumulative risks for construction worker.

Media	Pathway	HI	% HI	ILCR	% ILCR
Combined Surface Soil and Subsurface Soil	**Ingestion**	**1.E+00**	5%	**1.E-06**	1%
	Dermal	5.E-01	2%	3.E-07	0%
	Inhalation	**1.E+00**	6%	8.E-07	0%
	Subtotal	**3.E+00**	14%	**2.E-06**	1%
Upper Alluvial Groundwater	**Ingestion**	0.E+00	0%	0.E+00	0%
	Dermal	**1.E+01**	56%	**1.E-04**	86%
	Inhalation	**7.E+00**	30%	**2.E-05**	13%
	Subtotal	**2.E+01**	86%	**2.E-04**	99%
	TOTAL	**2.E+01**	100%	**2.E-04**	100%

Table 6-11. Summary of cumulative risks for industrial worker.

Media	Pathway	HI	% HI	ILCR	% ILCR
Surface Soil	**Ingestion**	6.E-01	45%	**3.E-06**	**61%**
	Dermal	6.E-01	48%	6.E-07	**13%**
	Inhalation	9.E-02	7%	**1.E-06**	**26%**
	Total	**1.E+00**	100%	**5.E-06**	**100%**

Table 6-14. Summary of cumulative risks for trespasser.

Media	Pathway	HI	% HI	ILCR	% ILCR
Surface Soil	**Ingestion**	1.E-01	14%	3.E-07	26%
	Dermal	3.E-01	31%	1.E-07	11%
	Inhalation	9.E-02	9%	7.E-07	52%
	Subtotal	6.E-01	53%	**1.E-06**	89%
Sediment	**Ingestion**	1.E-02	1%	7.E-08	5%
	Dermal	1.E-03	0%	8.E-08	6%
	Inhalation	2.E-02	2%	1.E-09	0%
	Subtotal	3.E-02	3%	1.E-07	11%
Surface Water	**Ingestion**	2.E-03	0%	0.E+00	0%
	Dermal	5.E-01	44%	0.E+00	0%
	Inhalation	0.E+00	0%	0.E+00	0%
	Subtotal	5.E-01	44%	0.E+00	0%
	TOTAL	**1.E+00**	100%	**1.E-06**	100%

CPCPRC RESPONSE TO EPA AND PREQB COMMENTS ON
July 2012 – Area of Concern Characterization Report
Chevron Phillips Chemical Puerto Rico Core, LLC Guayama, Puerto Rico
EPA ID No PRD991291972

January 31, 2013

The following comments have been developed based on the evaluation of the Area of Concern Investigation Report (Report) dated July 2012, submitted by North Wind on behalf of Chevron Phillips Puerto Rico Core, Inc. (CPCPRC), Guyama, PR.

General Comments[1]

The report should present information on the proposed future uses of the facility. This will help determine what potential future receptors may be found at the facility, the media that potentially need to be addressed, and what protective levels may be appropriate.

The risk-based screening levels (RBSLs) are presented in numerous tables in this report. However, the calculations for the values are not presented either in the report or in the footnote sections of the tables. It is difficult to verify these values without knowing where they came from. The report should clearly indicate what chemical was used as a surrogate for Sulfolane since there are no EPA-recommended RBSLs or toxicity values for this chemical. Although, Chevron mentioned during EPA-Chevron meetings that cleanup standards for the Texas Risk Reduction Program[2] were used for this analyte, the report does not state or explain its applicability. In addition, there are no RBSLs for sediment and surface water, the report should indicate how the RBSLs these media were calculated.

The Screening Level Ecological Risk Assessment includes evaluation of potential ecological risks from exposure to sediment and surface water in the Effluent Channel but excludes potential risks from exposure to the soil pathway. Appropriate justification should be provided as to why this potential ecological pathway was excluded from the report.

Response:

- Future Receptors and Protective Levels – it was clarified in the Report (Sections 1.2.1 and 3.4) that based on current surrounding land use and likely expectations of future land use, the site will remain industrial in nature. Accordingly, an industrial worker, a construction worker and a trespasser were identified as the potential onsite receptors. Offsite migration of groundwater and its use as drinking water by a hypothetical resident was also conservatively considered. The protective levels were developed for the potential receptors and the final RBSL was the lowest concentration that would be protective of the onsite receptors as well as the groundwater for the residential potable use.

- Risk-based Screening Levels (RBSL) – Detailed spreadsheets with media- and receptor-specific input and exposure parameters and equations are presented in Appendix B. All modified Skinner list chemicals are included. A spreadsheet for calculating the groundwater protective levels is also included. The final media-specific RBSLs were then compiled by taking the lowest concentration from the applicable receptors and pathways. The final RBSLs are summarized in Table B-1 in Appendix B.

- Sulfolane Toxicity – as a result of the teleconference with EPA and EQB on February 21, 2013, a Provisional Peer-reviewed Toxicity Value (PPRTV) has become available for sulfolane. The risk and RBSL calculations for sulfolane are based on the EPA-provided PPRTV.

- RBSLs for Surface Water and Sediment – The ecological screening levels for the modified Skinner list chemicals for the surface water and sediment are included in Appendix B. The reason they were

not presented in the main body of the Draft report is because there were no exeedances of the ecological screening levels and therefore, no chemicals of concern (COC).

- Screening Level Ecological Risk Assessment (SLERA) for Surface Soil – Screening of surface soil against ecological screening levels has been included in the revised SLERA (Section 6.2.1).

Specific Comments

1. Section 1.1 Purpose, third paragraph mentions that Sulfolane is not on EPA's Target Compound List, but was added during the implementation of the Soil Management Plan (SMP) when sulfolane was suspected beneath a demolished structure (Tank 540).

    Comment: *the EPA's Target Compound List was not mentioned on the SMP, the reasoning for such statement is unclear and confusing. Please, explain or omit. In addition, this paragraph should mention that Tank 540 was used for the storage of sulfolane and that during its removal/dismantling sulfolane was suspected beneath the tank/components structure.*

    Response: The reference to sulfolane not being on the EPA's Target Compound List has been removed. The text in Section 1.1 has been revised to indicate that Tank 540 was used for sulfolane storage and sulfolane was detected in the soil during the tank dismantling.

2. Section 1.2.1 *Site Setting and Use*, indicates that the surrounding area is predominantly industrial, with a small community, Las Mareas, south of the facility.

    Comment: *The information provided in this Section can be consolidated into Section 3.4, page 3-2, and should include the Reunion Ward, located north of the facility, as one of the nearby communities.*

    Response: Section 1.2.1 has been revised to include the Reunion Ward community to north. Section 3.4 is revised to include Reunion Ward as a community to the north of the Facility.

3. Section 2 *Area of Concern (AOC) Investigation*, summarizes the investigative activities related conducted at the facility/site during its demolition and dismantling events. The second paragraph mentions…the areas of potential contamination were identified and sampled. If the analytical results indicated contamination was present, the area was retained as an AOC for further investigation and characterization.

    Comment: *Rephrase the paragraph to indicate that the sampled areas were retained as an AOC when the analytical results exceeded the RBSLs.*

    Response: The suggested change has been made in the Section 2, second introductory paragraph.

4. Section 2.1 *AOC Investigation Sampling Program*, the four paragraph first bullets, indicates that prior to commencing fieldwork a potentiometric surface map was generated using water levels measured during the most recent sampling event.

    Comment: *Please, include the referenced map and the water levels measurements that were applied for its development.*

    Response: The potentiometric surface map used to help guide the AOC Investigation activities is now included in Appendix A along with the soil boring logs from the investigation.

5. Section 2.1.4 *Groundwater*, mentions that a few locations the boring was advanced beyond 20ft to 28ft. These borings were advanced to locate the clay aquitard located between the upper and lower alluvial aquifer. Water was not located at the borings during drilling, borehole locations (i.e., 0403-11, 0401-11).

   Comment: *The figures with the boreholes identification numbers are described in Figure F-6 to F-24. However, the Section does not make such reference. In order to ensure a thorough understanding of the investigation and these particular events, please, refer to the corresponding figures.*

   Response: Section 2.1.4 has been revised to indicate that the AOC sampling locations are presented on Figures 4-2 to 4-20, and the soil boring logs are presented in Appendix A.

6. Section 3.4 *Demographics and Land Use*, please refer to comment on item 2. In addition, please, include Las Mareas Ward, which is located south of the facility. A figure identifying this information as well as the location of the nearby properties will be an asset during the evaluation of other aspects of the investigation (e.g., conceptual site model).

   Response: Section 3.4 has been revised accordingly and Figure 1-1 now includes the location of Las Mareas and other nearby properties.

7. Section 4.2 *Surface and Subsurface Soil Results*, needs to be reviewed carefully since there are many errors present – spelling, missing words, tank numbers in the title do not agree with numbers in the text, maximum concentrations of chemicals do not agree with the number of chemicals listed etc. All of these errors should be corrected.

   Response: The information mentioned in the text has been verified against the data tables and figures for accuracy, and corrected as necessary.

8. Section 4.3.1, *AOC Groundwater Data*, mentions that the wells were sampled using low flow sampling techniques using peristaltic pump dedicated tubing.

   Comment: *A Puerto Rico's south coast groundwater study data, the Groundwater-Quality survey of the South Coast Aquifer of Puerto Rico[3], which was generated by the United States Geological Survey (USGS), suggests that Chevron's site might be affected by saline intrusion. Given, that the low flow sampling technique requires specific conductance readings to ensure well stabilization. These readings records could be useful to detect saline intrusion among other anomalies. Although, it is not under the scope of work of the approved AOC Work Plan, please, include (compact disk) and evaluate the monitoring wells stabilization recordings, particularly those related to conductivity.*

   Response: The field records for the open boreholes and monitoring wells sampled during the AOC Investigation are now included in Appendix A.

9. Section 4.7 *Extent of Contamination*, indicates that there is a Maximum Concentration Level for sulfolane; however, the Texas Commission of Environmental Quality (TCEQ) has adopted a standard of 320 µg/L for sulfolane in residential drinking water.

   Comment: *Currently, there is no EPA-recommended media specific risk-based screening value for sulfolane. The report indicates that TCEQ residential drinking water value was used for groundwater screening. However, the report does not explain or support the criteria applied for selecting the referenced screening values (i.e., groundwater media, surface soil). Given the scenario, the facility*

must develop site/media specific risk-based screening values for sulfolane and evaluate its nature and extent for further evaluation and remediation .

Response: Please see the response to the General Comment. Site-specific RBSLs have been developed for sulfolane based on the EPA-provided PPRTV for ingestion and screening PPRTV for inhalation.

10. Section 5.3 *Summary of Analysis*, mentions that migration and fate of both benzene and sulfolane, as well as other contaminants in groundwater, are influenced by the active application of interim measures. These measures along with natural attenuation process work to reduce contaminant mass and influence contaminant extent, fate and, transport.

    Comment: *EPA believes that such conclusion is premature and does not apply to sulfolane, given that further investigation is required.*

    Response: CPCPRC believes that with respect to benzene and sulfolane in groundwater, there is reduction in the contaminant mass because the EFR interim measure involves physical removal of the contaminated groundwater. Based on this comment and the February 21, 2013 call with EPA and EQB, a Supplemental RFI Work Plan for additional soil and groundwater investigation of sulfolane nature and extent has been submitted.

11. Section 6.1.2.3 *Potential Receptors*, the subsections headings must be renumbered. As presented, the resident subsection appears to be the sole potential receptor. In addition, the resident exposure pathway summary indicates that the groundwater contact would include direct ingestion, dermal contact and <u>inhalation of vapors emanating from the household usage of groundwater</u>. According to the report, these exposure pathways were quantitatively evaluated for assessing the potential risk to the resident.

    Comment: *The Residential Risk from Groundwater Vapor Intrusion into Buildings, AOC Report Appendix C, presents information that may contradict the above mentioned statement (highlighted), which does not consider exposure through vapor (volatilization) migration from groundwater to indoor air. Please review and modify as needed.*

    Response: The format for subsection headings have been corrected based on this comment.

    Section 6 includes a new section; Section 6.1.8 – Risks from Vapor Intrusion. This new section summarizes the potential inhalation risks from vapor intrusion. The detailed information for the vapor intrusion modeling is presented in Appendix D - Johnson and Ettinger Model.

12. Section 6.1.2.5, *Industrial Workers*, indicates that a limited numbers of workers remain at the site, and that the exposure was limited to surface soil. Exposure to subsurface soil, groundwater, surface water and sediment were considered to be incomplete exposure pathways.

    Comment: *The report shall consider or include Advanced Energy Systems (AES) employees as potential industrial receptors. According to the June 2012 Upper Alluvial and June 2011, benzene plume extends to AES property and benzene highest concentration was collected from wells nearby the property line (new well-1 234,000 ppb in 2011 and 190,000 ppb in 2012). Therefore, these potential receptors should be incorporated into the site's conceptual site model and evaluated accordingly.*

Response: The indoor vapor intrusion modeling presented in Appendix D has been revised to include an office worker in the AES administration building and a worker in the AES shed located near the southwest corner of the CPCPRC property.

13. Section 6.1.6.1, *Resident*, refer to item 11.

    Response: Comment noted, the format for Section 6.1.2.3 subsections has been corrected based on this comment.

14. Section 6.1.6.3, *Industrial Worker*, refer to item 12.

    Response: The revised indoor vapor intrusion modeling in Appendix D includes the onsite CPCPRC industrial worker *and* two structures on the AES property as mentioned in response to Item 12, above.

15. Section 7, *Summary and Conclusions*, mentions that the next step in the RCRA process as required by the Order will be to develop a work plan for the Corrective Measures Study.

    Comment: *As mentioned during the EPA/Chevron December 6, 2012 meeting, given to the findings of the AOC Investigation (i.e., sulfolane detections on groundwater and soil), is deemed necessary to determine the nature and extent of the sulfolane contamination and develop media specific risk based screening levels that are protective to human health and the environment. Consequently, a Supplemental RCRA Facility Investigation Report[4] shall be developed to describe the nature and extent of sulfolane, migration pathways, the potential threat to human health and the environment and it shall be used to support the corrective measures study.*

    Response: CPCPRC has submitted the Supplemental RFI Work Plan for additional soil and groundwater characterization for sulfolane. In addition, an outline for the Supplemental RFI Report has been included with the revised AOC Investigation Report as Appendix F.

Figures

16. Figures 4-22, *June 2012 Benzene Lower Alluvial Aquifer* and Figure 4-29, *June 2012 Sulfolane Lower Alluvial Aquifer*, identify the concentrations of benzene and sulfolane, respectively, at the lower alluvial from on-site and off-site monitoring wells. However, the figure is not legible and this information is not presented as intended. Please modify the figures as necessary.

    Response: The figures have been revised to be legible, and to show the concentrations of benzene and sulfolane in the lower aquifer.

Tables

17. Tables 4-3 – 4-5 indicate that antimony was not detected in any of the ten surface soil or subsurface soil background samples However, in a total of 259 soils samples, antimony was detected 55 times in surface soil samples and 47 times in subsurface soil samples for a total of 102 detections. The statistical conclusion for antimony is that it is below or equal to background. This conclusion seems to be incorrect.

    Response: The EPA software ProUCL takes into account the distribution of the detection limits for the non-detected data. Based on a statistical comparison of the detected concentrations and the detection limits, the software concluded that site antimony is not above background. It is noted that a

similar situation exists with cadmium which was not detected in the background samples; however, ProUCL determined that the site cadmium was above background.

It is further noted that metals were not excluded from risk calculations. Potential risks both with and without background metals were discussed separately in Section 6.3 - Uncertainty Analysis.

18. Tables 6-4 – 6-5 and 6-9 – 6-10, were included on the provided compact disk, but were not presented on the hardcopy report. Please, explain the discrepancy.

    Response: Due to the large size of these tables they are not printed in hardcopy. In addition, we believe examination and review of the content of the electronic versions (i.e., the spreadsheet formulas and calculations) will be easiest for EPA and PREQB.

19. Appendix C – Johnson and Ettinger Model (Technical Memorandum: Residential Risks From Groundwater Vapor Intrusion Into the Buildings-Memo), indicates that CPCPRC used the Johnson and Ettinger model assess the potential risk occupants in a hypothetical structure either on the CPCPRC Facility or in off-site area adjacent to the facility.

    Comment: *The EPA does not recommend modeling as the only line of evidence to screen out a site. It is most appropriately used in conjunction with other lines of evidence (e.g., indoor air data, concurrent outdoor air data, soil gas data). In addition, the data that was generated as a result of such modeling should have been clearly identified and explained on Section 6, Baseline Risk Assessment, of the Report and respective tables. The Technical Memorandum does not include industrial workers from the nearby facility (i.e., AES) as receptors, and as a result, it does not consider the factors derived from this scenario. In addition, the buildings dimensions applied for the residential scenario are not realistic to the local housing dimensions (i.e., 12 ft ceilings, 1000 square feet).*

    Response: As mentioned in the Response to Item 11, two structures on the AES property were evaluated. No area or media were screened out from further consideration based on the vapor intrusion modeling. It is noted that the vapor intrusion modeling demonstrates that the chemicals of concern in the modeled indoor air are the same as those identified as in the HHRA (i.e., the BTEX constituents).

APPENDIX G

Outline for the Supplemental RFI Report

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Supplemental RFI Report – Annotated Outline

Acronyms and Abbreviations

1.0   Introduction
        1.1   Purpose
                1.1.1   SRFI Investigation Objectives and Approach
        1.2   Site Background
        1.3   Site Setting and Use
        1.4   Topography and Physiography
        1.5   Surface Water Features
        1.6   Climate and Precipitation
        1.7   Demographics and Land Use
        1.8   Previous Investigations
                1.8.1   RFI Investigations
                1.8.2   AOC Investigations
        1.9   Semi-Annual Groundwater Sampling
        1.10   Ongoing Interim Actions

2.0   Investigation Data
        2.1   RFI Data Summary
                2.1.1   Analytical Data – brief discussion of analytical data (i.e., no sulfolane and AOC
                        Report to cover other COCs)
                2.1.2   Hydrogeology
        2.2   AOC Investigation Sulfolane Data Summary
                2.2.1   Surface Soil
                2.2.2   Subsurface Soil
                2.2.3   Groundwater
        2.3   Semiannual Monitoring Sulfolane Data Summary
        2.4   Supplemental RFI Data
                2.4.1   Surface Soil
                2.4.2   Subsurface Soil
                2.4.3   Groundwater

3.0   Nature and Extent of Sulfolane Contamination
        3.1   Surface Soil
        3.2   Subsurface Soil
        3.3   Groundwater

4.0   Fate and Transport of Sulfolane
        4.1   Lithologic and Other Physical Considerations
        4.2   Natural Attenuation
                4.2.1   Adsorption
                4.2.2   Biodegradation
                4.2.3   Volatilization to the Atmosphere

Attachments
A complete analytical database and spreadsheets used for risk calculations are provided with this report in electronic format on compact disk (CD).